Fischer Athena Mammovision

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ALIGNMENT AND CALIBRATION

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X-Ray Tube Warm-Up and Seasoning Procedures

X-Ray Tube Warm-Up Procedure

Caution The following tube warm-up procedure is only a sample that may be used with a typical x-ray tube. Consult the x-ray tube manufacturer's documentation for specific warm-up recommendations. Where the recommendations of the manufacturer conflict with this procedure, comply with the manufacturer's directions. an incorrect warm-up may lead to premature x-ray tube failure.

1. Make the following technique selections:
   28 kV
   100 mA
   120 mAs
2. Make 3 exposures, waiting approximately 30 seconds between exposures.

Caution Minimize filament evaporation by keeping the rotor "ON" time short and avoiding long standby periods. Excessive evaporation can lead to premature x-ray tube failure.

X-Ray Tube Seasoning Procedure

Perform the following tube seasoning procedure for any new x-ray tube, or for any x-ray tube that has not been used for seven or more days before operating the tube at maximum kV.

1. Make the following technique selections:
   30 kV
   100 mA
   100 mAs
2. Make 6 exposures, waiting approximately 5 seconds between exposures.
3. Wait 30 seconds.
4. Make 5 additional exposures, waiting approximately 60 seconds between exposures.
5. Allow the x-ray tube to cool for 30 minutes.

Athena Alignment and Calibration

Counterbalance Adjustment

Counterbalancing is needed on a stand-alone Athena system when additional options are field installed. The counterbalancing provides weight to balance the weight of the **x-ray arm**. When the x-ray arm and counterbalance are in balance, moving the tube arm up requires the same amount of force as moving the arm down.

The round counterweight is included with each option package, and is installed as follows.

1. Turn system power OFF.
2. Remove the tubestand cover plate. Four flat-head metal screws must be removed to lift the cover plate off of the tubestand.
3. Turn system power ON.
4. Push the Vertical Lock button.
5. Move the tube arm assembly until the top of the factory-installed counterweight is level with the tubestand opening.
6. Turn system power OFF.
7. Place the counterweight over the eyebolt that holds the factory installed counterweight.

Vertical Pulley/Brake Adjustment

This procedure involves the following two adjustments:

- The top brake arm travel and clearance
- The override pressure for the brake

1. Turn system power OFF.
2. Remove the tubestand cover plate. Four flat-head metal screws must be removed to lift the cover plate off of the tubestand.
3. Turn system power ON.
4. Press the vertical release button and activate the vertical pulley/brake.
   - Check that the top brake rack arm fully engages the spur gear when the pulley/brake is engaged.
   - When the pulley/brake is not engaged, check that the top brake rack arm just barely clears the spur gear. Too much clearance causes the engaged position to prematurely fail.

Continued on next page

Athena Alignment and Calibration, *continued*

Vertical Pulley/Brake Adjustment, *continued*

5. To correct the travel and clearance for the top brake arm, adjust the eccentric cam using the following procedure:
   a. Loosen the 10-32 x 3/8 locking set screw.
   b. Place a small allen wrench or screwdriver in the hole drilled through the outside of the eccentric cam. This provides the leverage to rotate the cam.
   c. Rotate the cam until the connector link is approximately perpendicular to the floor. The arm brake support will be level with the floor. When rotating the cam, the cam pin should always remain on the side of the solenoid.
6. Repeat steps 4 and 5 until the brake travel and clearance is adjusted correctly.
7. Adjust the brake override by tightening and loosening the two screws installed through the disk brake. Adjust the screws equally, so that approximately 50 lbs of force are needed to move the arm downward with the locks engaged.

Auto Compression Belt Adjustment

With power on, the compression paddle should not move until approximately 40 lbs of force are applied after compression is released.

With power off, the compression paddle should slide downward smoothly and easily.

To adjust the force needed to move the compression paddle with power applied, tighten or loosen the belt tightening screws at the base of the image receptor support column.

Athena Alignment and Calibration, *continued*

Image Alignment

The following adjustments affect image alignment:

Table 1: Summary of Image Alignment Adjustments

Adjustment	Level	Direction	Effect
TubeTilt	Coarse	front to back movement	moves x-ray and light fields in relation to the image receptor
Collimator Pivot Screw	Coarse	side to side movement	moves x-ray and light fields in relation to the image receptor
Mirror		front to back movement	moves light field in relation to the image receptor and x-ray field
Left/Right Collimator Joint Plate		skews movement	moves x-ray and light fields in relation to the image receptor
Left Collimator Joint Plate	Fine	front to back movement	moves x-ray and light fields in relation to the image receptor
Right Collimator Joint Plate	Fine	side to side movement	moves x-ray and light fields in relation to the image receptor
Lamp Vertical	Fine	overall size and front to back movement	moves light field in relation to the x-ray field and image receptor
Lamp In/Out	Fine	focal distance	moves the light focal distance in relation to the image receptor

Careful attention to the coarse adjustments will simplify the fine adjustments made later.

Verify alignment adjustments using the functional check section **Alignment Checks and Procedures**.

Continued on next page

Athena Alignment and Calibration, *continued*

Image Alignment, *continued*

Adjusting the X-Ray Tube Tilt

1. Loosen and tighten the two hex nuts on the threaded rod to raise or lower the collimator bracket.
2. Make an x-ray with the front (patient) edge of the x-ray field lined up with the front edge of the film.
3. Carefully examine the x-ray for alignment.
4. Repeat **step 2** and **step 3** until the tilt of the collimator is correct.

Adjusting the Collimator Pivot Screws

1. Loosen the locking screws on both sides of the collimator.
2. Slide the diagnostic source assembly (tube and collimator) back and forth to center it from right to left.
3. Make an x-ray with the front (patient) edge of the x-ray field lined up with the front edge of the film.
4. Carefully examine the x-ray for alignment.
5. Repeat **step 3** and **step 4** until the tilt is correct.
6. Tighten the locking screws.

Adjusting the Mirror

To remove the collimator mirror:

1. Remove the x-ray tube.
2. Remove the collimator.
3. Remove the mirror positioning screw and the two set screws.
4. Remove the mirror.

To adjust the collimator mirror alignment:

1. Loosen the screw located on the right side of the collimator.
2. Tilt the mirror to the desired angle by sliding the screw in the slotted channel.
   - To move the light towards the front of the image receptor, tilt the mirror down by moving the screw up.
   - To move the light away from the front of the image receptor, tilt the mirror up by moving the screw down.
3. Tighten the screw.

Continued on next page

Athena Alignment and Calibration, *continued*

Image Alignment, *continued*

Adjusting the Left/Right Collimator Joint Plate

The right collimator **joint plate** is secured with two vertically mounted screws. Adjusting these screws controls the left-right alignment of the x-ray field.

The left collimator plate is secured with two horizontally mounted screws. Adjusting these screws controls the skew alignment of the x-ray field.

Loosening all four screws allows adjustment of the front to back alignment of the x-ray field.

Collimator Lamp and Socket Removal

Caution	Do not touch the collimator lamp, as it may be hot enough to cause severe burns.

1. Turn system power OFF.
2. Remove the **collimator cover**.
3. Remove the 2 screws holding the lamp and socket.

Caution	Use a clean piece of plastic or tissue to handle the lamp, since skin oils and other substances can cause the glass to break when the lamp is turned on.

4. Remove the lamp and socket.

Athena Alignment and Calibration, *continued*

Image Alignment, *continued*

Collimator Lamp Alignment

Aligning the collimator lamp will change the light focal distance. It will also have a slight affect on the size of the projection field.

1. Remove the lamp cover.
2. Loosen the lamp screws.
3. Re-position the lamp as needed.
   - Moving the lamp up and down moves the light field from front to back.
   - Tilting the lamp corrects for skew.
   - Adding washers beneath the lamp bracket changes the overall focal distance. The focal distance enhances the light field edge definition, however, this adjustment is only rarely needed.

Collimator Mirror Removal

1. Remove the x-ray tube.
2. Remove the collimator.
3. Remove the mirror positioning screw and the two securing set screws.
4. Remove the mirror.

Collimator Mirror Alignment

This adjustment is used to position the light field from front to back.

1. Loosen the mirror positioning screw located on the right side of the collimator.
2. Tilt the mirror by moving the screw up and down in the slotted channel.
   - Moving the screw up tilts the mirror down and moves the light field toward the front of the cassette.
   - Moving the screw down tilts the mirror up and moves the light field toward the back of the cassette.

Athena Alignment and Calibration, *continued*

Software Configuration

The Athena system software will need configuration at startup, and if error message 10 displays or if the RAM or the CPU board is replaced.

1. To enter the configuration mode, turn SW1 (found on the CPU board) to position 1.
2. Press SW2 (also on the CPU board) and confirm that the Athena is in configuration mode by verifying that all the control panel windows except for the mA window are blank. The value shown in the mA window is the current system configuration.
3. Press the mA up and down buttons to select the system setting from the **Athena System Settings** table below.
4. To return to standard operating mode, turn SW1 on the CPU board to position 0, then press SW2.

Table 2: Athena System Settings

System Setting	Binary Code	Hoorn Bucky	Mammovision	Collimator Aperture	Bucky (2 slot)	Compression	Sinmed Bucky Drive	Bucky (1 slot)	AEC
0	00000000	0	0	0	0	0	0	0	0
8	00001000	0	0	0	0	1	0	0	0
9	00001001	0	0	0	0	1	0	0	1
11	00001011	0	0	0	0	1	0	1	1
25	00011001	0	0	0	1	1	0	0	1
57	00111001	0	0	1	1	1	0	0	1
97	01100001	0	1	1	0	0	0	0	1
137	10001001	1	0	0	0	1	0	0	1

Athena Alignment and Calibration, *continued*

mA Calibration

Note The Athena generator will only accept calibration adjustments at 20, 28, 36 and 44 kV. The mA and boost reference values for other kV settings are extrapolated from these settings.

1. Turn **SW1** (found on the CPU board) to position 1.
2. Press **SW2** (also on the CPU board). The Film/ Screen III button will flash, indicating that calibration mode is active.
3. Press the Film Screen I button to activate mA calibration. The mA calibration value will be displayed in the mA window.
4. Press the mA Up or mA Down buttons to adjust the mA calibration value. The mA calibration value will be adjusted by 1 (hex) for each press.
5. Turn **SW1** to 0.
6. Press **SW2**. This returns the machine to standard operation mode.

Table 3: Default Calibration Values

kV Servo Values					
Focal Spot	mA Station	kV Station			
		20	28	36	44
Small	15	12	5C	A5	EE
	25	12	5C	A5	EE
	30	12	5C	A5	EE
Large	100	12	5C	A5	EE
	125	12	5C	A5	EE
Filament Drive Values (Current/Boost)					
Focal Spot	mA Station	kV Station			
		20	28	36	44
Small	15	195	195	195	195
	25	2A3	2A3	2A3	2A3
	30	32A	32A	32A	32A
Large	100	A8C	A8C	A8C	A8C
	125	D2F	D2F	D2F	D2F

Athena Alignment and Calibration, *continued*

mA Calibration, *continued*

Table 3: Default Calibration Values, continued

mA Boost Values					
Focal Spot	mA Station	kV Station			
		20	28	36	44
Small	15	55	44	42	46
	25	B4	5C	4B	—
	30	86	68	—	—
Large	100	94	8B	82	—
	125	AA	96	—	—

Table 4: Typical Calibration Values

kV Servo Values					
Focal Spot	mA Station	kV Station			
		20	28	36	44
Small	15	12	5C	A5	EE
	25	12	5C	A5	EE
	30	12	5C	A5	EE
Large	100	12	5C	A5	EE
	125	12	5C	A5	EE
Filament Drive Values (Current/Boost)					
Focal Spot	mA Station	kV Station			
		20	28	36	44
Small	15	195	195	195	195
	25	2A3	2A3	2A3	2A3
	30	32A	32A	32A	32A
Large	100	A8C	A8C	A8C	A8C
	125	D2F	D2F	D2F	D2F

Athena Alignment and Calibration, *continued*

mA Calibration, *continued*

Table 4: Typical Calibration Values, continued

mA Boost Values					
Focal Spot	mA Station	kV Station			
		20	28	36	44
Small	15	91	85	89	77
	25	EB	9F	92	—
	30	D4	BD	—	—
Large	100	F3	DD	DD	—
	125	FF	EF	—	—

Athena Alignment and Calibration, *continued*

mA Boost Calibration

Table 5: Technique Selections for Calibration (M147)

mA Selected	mAs Selected	mAs Long Exp.	kV Selected	kV Calibrate
100	10	200	22	20
100	10	200	28	28
100	10	200	35	36
30	3	60	26	20
30	3	60	27	28
15	1	30	20	20
15	1	30	28	28
15	1	30	36	36
15	1	30	39	44
25	2	50	23	20
25	2	50	28	28
25	2	50	33	36
125	10	250	24	20
125	10	250	28	28

1. Turn **SW1** (found on the CPU board) to position 1.
2. Press **SW2** (also on the CPU board). The Film/Screen III button will flash, indicating that calibration mode is active.
3. Select
   100 mA
   28 kV
   10 mAs
   as shown in the second row of the **Technique Selections for Calibration (M147)** table.
4. Press the Film/Screen III button to take an exposure.
5. Check the actual mA displayed in the mA window.
6. If the actual mA is not equal to the selected mA, press the kV button to display the boost data value in the mA window.
   - If the actual mA is less than the selected mA, press the mA Up button to increase the boost data value.
   - If the actual mA is greater than the selected mA, press the mA Down button to decrease the boost data value.

Continued on next page

Athena Alignment and Calibration, *continued*

mA Boost Calibration, *continued*

7. Repeat steps 3-6 until the actual mA is equal to the selected mA.
8. Record the boost data value in the **Software Data Values** record sheet.
9. Select
   100 mA
   22 kV
   10 mAs
   as shown in the first row of the **Technique Selections for Calibration (M147)** table.
10. Press the Film/Screen III button to take an exposure.
11. Check the actual mA displayed in the mA window.
12. If the actual mA is not equal to the selected mA, press the kV button to display the boost data value in the mA window and select the 20 kV calibration number.
    - If the actual mA is less than the selected mA, press the mA Up button to increase the boost data value.
    - If the actual mA is greater than the selected mA, press the mA Down button to decrease the boost data value.
13. Repeat steps 9-12 until the actual mA is equal to the selected mA.
14. Record the boost data value in the **Software Data Values** record sheet.
15. Select
    100 mA
    35 kV
    10 mAs
    as shown in Table 3: Technique Selections for Calibration.
16. Press the Film/Screen III button to take an exposure.
17. Check the actual mA displayed in the mA window.

Continued on next page

Athena Alignment and Calibration, *continued*

mA Boost Calibration, *continued*

18. If the actual mA is not equal to the selected mA, press the kV button to display the boost data value in the mA window and select the 36 kV calibration number.
    - If the actual mA is less than the selected mA, press the mA Up button to increase the boost data value.
    - If the actual mA is greater than the selected mA, press the mA Down button to decrease the boost data value.
19. Repeat **step 15** to **step 18** until the actual mA is equal to the selected mA.
20. Record the boost data value in the **Software Data Values** record sheet.
21. Select
    30 mA
    27 kV
    3 mAs
    as shown in the **Technique Selections for Calibration (M147)** table.
22. Press the Film/Screen III button to take an exposure.
23. Check the actual mA displayed in the mA window.
24. If the actual mA is not equal to the selected mA, press the kV button to display the boost data value in the mA window and select the 28 kV calibration number.
    - If the actual mA is less than the selected mA, press the mA Up button to increase the boost data value.
    - If the actual mA is greater than the selected mA, press the mA Down button to decrease the boost data value.
25. Repeat **step 21** to **step 24** until the actual mA is equal to the selected mA.
26. Record the boost data value in the **Software Data Values** record sheet.
27. Select
    30 mA
    26 kV
    3 mAs
    as shown in the **Technique Selections for Calibration (M147)** table.

Continued on next page

Athena Alignment and Calibration, *continued*

mA Boost Calibration, *continued*

28. Press the Film/Screen III button to take an exposure.
29. Check the actual mA displayed in the mA window.
30. If the actual mA is not equal to the selected mA, press the kV button to display the boost data value in the mA window and select the 20 kV calibration number.
    - If the actual mA is less than the selected mA, press the mA Up button to increase the boost data value.
    - If the actual mA is greater than the selected mA, press the mA Down button to decrease the boost data value.
31. Repeat steps 27-30 until the actual mA is equal to the selected mA.
32. Record the boost data value in the **Software Data Values** record sheet.
33. Use the same procedure as in **step 27** to **step 32** to set the mA boost for the remaining rows in the **Technique Selections for Calibration (M147)** table. The kV Calibrate column is used to determine the kV station used to enter the boost data.
34. Repeat the entire procedure using the long exposure times in the "mAs Long Exp." column of the Technique Selections for Calibration table.
35. When calibration is complete, turn **SW1** to 0.
36. Press **SW2**. This returns the machine to standard operation mode.

Athena Alignment and Calibration, *continued*

CompuTracII Gain Adjustment

Important! Calibrate kV and mA before performing any AEC calibration. A small error (as little as 0.5 kV) can cause the optical density to vary by as much as 30%.

Note If the CompuTracII Gain is adjusted, the algorithm results are no longer optimized, resulting in greater variation in film exposures due to target thickness or kV variations.

1. Turn the CompuTracII ON.
2. Select:
   28 kV
   100 mA
   750 mAs
3. Load the film cassette with OM-1 film and a Min-R screen.
4. Place the RMI Mammographic Accreditation Phantom (Model 156), the moving grid, compression paddle, and loaded film cassette in the x-ray beam's path.
5. Verify that the AEC detector is in position 2.
6. Make an exposure.
7. Note the exposure time.
8. Develop the film.
9. Check the optical density of the film.
10. If the optical density is not within 1.25 ±15%, adjust R9 on the Preamp Board.
11. Repeat steps 6 through 10 until an acceptable density is achieved.

Film Screen Calibration

1. In manual mode, select a combination of mA and kV stations that achieve an optical density of 1.25 (or whatever density the institution prefers) with an exposure time of 1 to 2 seconds for a given target.
2. Record the kV, mA, mAs and optical density values. This is the target mAs.
3. Select AEC and the station you are calibrating (Film/Screen II or Film Screen III).
4. Select the kV and mA determined above.
5. Using the same target as above, make an exposure.

Continued on next page

Athena Alignment and Calibration, *continued*

Film Screen Calibration, *continued*

6. Record the kV, mA, mAs and optical density values. This is the calibrated mAs value.
7. Turn **SW1** (found on the CPU board) to position 1.
8. Press **SW2** (also on the CPU board). The Film/ Screen III button will flash, indicating that calibration mode is active.
9. Using the kV Up and kV Down controls on the front panel:
   - Select 58 kV if Film/Screen II is being calibrated
   - Select 59 kV if Film/Screen III is being calibrated
10. Press the appropriate Film/Screen button.
11. Adjust the density offset value shown in the mA window as follows:
    - If the target mAs value is greater than the calibrated mAs value, increase the density offset value by 1 or 2
    - If the target mAs value is less than the calibrated mAs value, decrease the density offset value by 1 or 2
12. Turn **SW1** to 0.
13. Press **SW2**. This returns the machine to standard operation mode.
14. Repeat **step 4** to **step 13** until the target mAs value matches the calibrated mAs value.

Mammotest/Mammovision Alignment and Calibration

X-Ray Tube Alignment

X-Ray tube alignment is only necessary after replacing the x-ray tube.

1. Remove the **collimator cover**.
2. Side to side adjustment:
   a. loosen the two allen socket locking screws (one per side)
   b. slide the tube assembly left or right as needed
   c. tighten the locking screws
3. Up/Down adjustment:
   a. loosen the allen screw inside the collimator
   b. adjust the allen screw on the lower right side of collimator assembly
   c. tighten the allen screw inside the collimator

X-Ray Beam to Camera Alignment

1. Install the 1.3 x 1.3 cm aperture.
2. At the Mammovision screen, select:
   Utilities
   Get Images
   Acquire Raw
   Exposure Control
   Manual
   Store A
3. Select:
   25 kV
   100 mA
   10 mAs
   and manual mode at the generator cabinet.
4. Move everything out of the x-ray beam.
5. Make an exposure.
6. Check that a raw image is sent to the Mammovision monitor.
7. Examine the image for collimator centering, and uniformity. Make adjustments to the x-ray tube as required.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

X-Ray Beam to Camera Alignment, *continued*

8. Repeat **step 2** to **step 7** until the image is centered on the monitor.

Important! The x-ray field must cover the top edge of the image, since the AEC level is read off of the top serial register.

9. At the Mammovision screen, select:
   Done
   Done

Compression Tension Adjustment

1. Check that jumper JP1 is installed on the compression drive circuit board.
2. Rotate the **"Auto-Compression Pressure Adjustment" potentiometer** fully counter-clockwise (to the 10 setting).
3. Set the potentiometers on the compression drive circuit board as follows:
   - Potentiometer R32 "Maximum Force" - fully counterclockwise (minimum setting)
   - Potentiometer R24 "Minimum Force" - fully counterclockwise (minimum setting)
   - Potentiometer R18 "Compression Velocity" - fully clockwise (maximum setting)
4. Adjust the minimum force as follows:
   a. Install a force gauge between the center of the compression paddle and the breast support.
   b. Compress the mechanism.
   c. Adjust the R24 (Minimum Force) potentiometer until the compression force is 12 ±2.5 lbs.
   d. Release the mechanism.
5. Adjust the maximum force as follows:
   a. Rotate the "Remote Control" potentiometer to its maximum position.
   b. Install a force gauge between the center of the compression paddle and the breast support.
   c. Compress the mechanism.
   d. Adjust the R32 (Maximum Force) potentiometer until the compression force is 40 ±4 lbs.
6. Set the "Remote Control" potentiometer to its minimum setting (0).

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Compression Tension Adjustment, *continued*

7. Measure the minimum force.
8. If the minimum force is not 12 ±2.5 lbs, readjust the R24 (Minimum Force) potentiometer.
9. Adjust the Compression Velocity as follows:
   a. Position the compression paddle at the end of its travel away from the breast support.
   b. Rotate the "Remote Control" potentiometer to it's maximum position (10).
   c. Compress the compression device using the foot switch.
   d. Adjust the R18 (Compression Velocity) potentiometer counterclockwise until the maximum compression force drops below 35 lbs.
   e. Compress the compression device using the foot switch.
   f. Adjust the R18 (Compression Velocity) potentiometer clockwise until the maximum compression force is 40 ±4.0 lbs.
10. Set the "Remote Control" potentiometer to its minimum setting (0).
11. Measure the minimum force.
12. If the minimum force is not 12 ±2.5 lbs, readjust the R24 (Minimum Force) potentiometer.

Camera Gain Adjustment

1. Insert the dosimeter probe in the compression paddle window.

Important! The probe must be fully covered by the un-attenuated x-ray beam. If the dosimeter probe is larger than the compression paddle window, remove the paddle and install a larger apera-ture.

2. Select
   25 kV
   100 mA
   10 mAs
   RAW exposure
3. Make an exposure.
4. Record the exposure level. The altitude corrected (true mR) exposure level should be between 64.25 and 85.75 mR. If it is not, complete the **Athena Alignment and Calibration** before proceeding.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Camera Gain Adjustment, *continued*

5. Remove the dosimeter probe.
6. Select
   25 kV
   100 mA
   10 mAs
   RAW exposure
7. Make an exposure.
8. At the Mammovision screen, select:
   Done
   Image Analysis
   ROI
9. Draw an ROI of approximately 300 x 300 pixels in the center of the image.
10. At the Mammovision screen, select:
    Stats
11. Examine the ADU (average) value in the lower right corner of the screen.
12. Using the **Camera Gain vs. Altitude Compensated mR Reading** graph below:

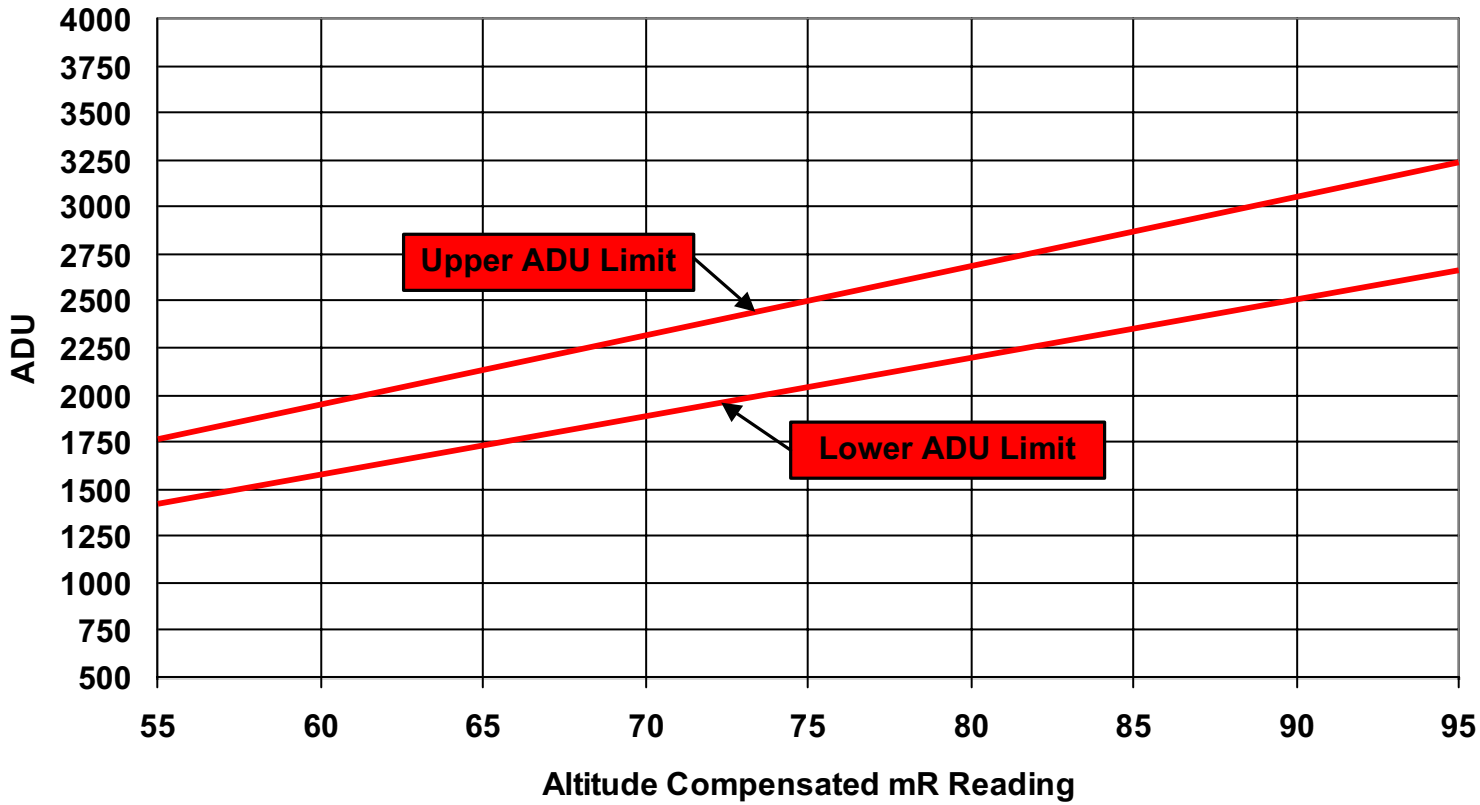


Figure 1: Camera Gain vs. Altitude Compensated mR Reading

a. Locate the point on the graph that represents the intersection of the altitude compensated mR reading from step 4 and the ADU value from **step 11**.

b. Verify that this point is roughly in the middle between the ADU limits shown on the graph.

Mammotest/Mammovision Alignment and Calibration, *continued*

Camera Gain Adjustment, *continued*

13. If the ADU value is not acceptable, perform the following adjustments:

    a. Properly attach and ground a wrist or ankle strap.

    b. Make a 0 second dark exposure.

    c. Check the average ADU reading.

    d. Adjust the **Offset potentiometer** and repeat until the average ADU reading is between 50 and 100.

    e. Select
       25 kV
       100 mA
       10 mAs
       RAW image
       No beam attenuation

    f. Make an exposure.

    g. Locate the point on the graph that represents the intersection of the altitude compensated mR reading from step 4 and the ADU value from step g.

    h. Adjust the **Gain potentiometer** and repeated **step e** through **step g** until the ADU value is within tolerance.

Mammotest/Mammovision Alignment and Calibration, *continued*

Mapping the Camera Defects

Camera defects are mapped each time the camera is replaced with a different camera.

If a floppy disk was received with the camera, it will contain the defects map, and this procedure is unnecessary.

1. Install the 5 x 5 cm aperture.
2. Set the x-ray tube position to take a straight on exposure.
3. Remove any phantoms as well as the compression paddle.
4. At the Mammovision screen, select
   Utilities
   Install
   Defect Mapping and Editor
   Run Defect Test
5. At the generator, select:
   23 kV
   100 mA
   10 mAs
6. Acquire 8 images as prompted by the Mammovision program.
7. On the summary sheet displayed after the program is finished computing the defects, check the total number of defects. Proceed as follows:

- If the number of defects is less than 50, increase the number of defects found as follows:
  a. Change the hot defect limit by selecting
     Defect Map Test Limits
     Hot Pixel Limit
  b. Lower the limit.
  c. Select
     Done
  d. Repeat **step 4** to **step 7**.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Mapping the Camera Defects, *continued*

- If the number of defects is between 50 and 5000, proceed to **step 8**.
- If the number of defects exceeds 5000, verify that a beam dispersion or similar problem does not exist, then decrease the number of defects found as follows:

  a. Change the hot defect limit by selecting
     Defect Map Test Limits
     Hot Pixel Limit

  b. Raise the limit.

  c. Select
     Done

  d. Repeat **step 4** to **step 7**.

8. Check for uncorrected defaults by selecting
   List UnCorrected Defects

   - If uncorrected defects are found, record each of these defects for later use. After saving the defect map, proceed to **Editing the Defects Map**.

9. Select
   Save Defect Map

10. If a message asks if you want to over-write an existing defect map, select
    Yes

Editing the Defects Map

The defects map should only be edited if uncorrected defects are found during the **Mapping the Camera Defects** procedure.

1. At the Mammovision screen, select
   Edit Defects Map
   Insert Entry

2. On the screen, a new line, with Type, Offset, Start, End, and Remedy defaults will be shown. Edit this line as follows:

   - Change the "Offset" to match the x value of the defect
   - Change the "Start" value to match the top y value of the defect
   - Change the "End" value to match the bottom y value of the defect

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Editing the Defects Map, *continued*

- Set the Remedy to one of the following values:
  - Average: averages the values of the column to the right and the column to the left of the defect and uses the result as the defect value. This is the preferred Remedy choice.
  - Left: uses the value of the column to the left as the defect value.
  - Right: uses the value of the column to the right as the defect value.

3. Repeat for each uncorrected defect found in the "Mapping the Camera Defects" procedure.
4. At the Mammovision screen, select
   Done
   Save Defect Map
   Done
   Done
   Done
5. Backup the defect map to a floppy as follows:
   a. Insert a blank, formatted, floppy into the floppy drive
   b. Enable the DOS prompt.
   c. At the DOS prompt, type
      copy c: \ess\defects.dat a:

Camera Calibration and Mapping for Distortion

This calibration procedure is used for fiber optic distortion reduction.

1. In the Mammovision software, enable the "Defect Fix Image" and "Enhanced Correct" options. These options are found at the
   Utilities
   Install
   System Config
   screen.
2. Install the 9 x 9 cm aperture.
3. Select the technique factors specified by the customer for the warm-up procedure.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Camera Calibration and Mapping for Distortion, *continued*

4. At the Mammovision screen, select
   Utilities
   Daily Calibrate
   This acquires a 0.1 second and a 9.9 second dark image from the camera. Proceed to the next step when the calibration has finished.
5. Make 8 successive manual exposures without changing the technique factors.
6. At the Mammovision screen, select
   Utilities
   Analysis
   Get Images.
7. Tape the distortion phantom on the carbon fiber plate within the field of view.
8. Make an corrected exposure of the phantom such that the background level is around 2000. (e.g. 26 kV, 100 mA and 40-80 mAs)
9. Record the technique factors used.
10. At the Mammovision screen, select
    Get Images
    Acquire Corrected
    A
11. View the acquired image, and check the following:
    - the phantom is centered in the field of view
    - no circle touches the edge of the screen
    - the rows and columns are fairly straight across
    - the big circle should be in the center of a 15 x 15 cm square
    - seven rows of circles on the top, seven rows of circles on the bottom, seven columns of circles on the left and seven columns of circles on the right are all visible.
12. If the image does not meet the criteria above, reposition the phantom and re-take the images until the alignment is correct.
13. From the main Mammovision screen, select
    Utilities
    Install

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Camera Calibration and Mapping for Distortion, *continued*

14. When the system asks for a password, enter
    fischer
    Distort Mapping
15. Enter the camera's three digit serial number. (leading zeros will be added by the program)
16. Select
    Create Map
17. If the message
    Unable to read the phantom description file from disk. The data will be initialized to default values shown, click on OK.
18. Select
    Acquire Image
19. Select the technique factors that were recorded in **step 9**.
20. If the message
    Overwriting the Current Map
    is shown, click Yes.
21. Start the function to map this image.
22. Select
    Find the Centroids
23. Select a threshold type.
24. Select
    3/4 maximum pixel value
25. Draw an ROI around a random BB, including a significant portion of background.
26. Select
    Done
27. Test the threshold as shown below.
    a. Click on a circle in each corner and on the center circle.
    b. Check that the circles are red, but no background is red.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Camera Calibration and Mapping for Distortion, *continued*

28. If the circles are not red
    a. Select Cancel until you reach the Distort Mapping screen.
    b. Select Describe Phantom.
    c. For Phantom 89385, check that the diameter of the big circle is about 12 pixels and the small circle diameter is about 8 pixels.
    d. Check that the distance between columns and the distance between rows is set to 0.3175 cm.
    e. Select Done.
    f. Select Yes to save the information to disk.
    g. Test the threshold again.
    h. If the threshold still is incorrect, retake the image using different technique factors.
    i. Repeat steps 18 trough 28 until the threshold tests correctly.
    j. Select Done.
29. When all of the circles have been found, indicate the center circle.
30. If the rectangle is not centered over the circle, use the mouse to move it to the correct position.
31. Select
    Done.
32. Select
    Half Res
    mode to check the results.
    - Results should show an array of dots indicated from 0,0 to 18,18.
    - The circle centers should be in the correct spots
    - the extrapolated dots should seem reasonable.
33. Click OK until you get back to the distort mapping screen.
34. Select
    Done
    Done
    Done
    Distort Map Screen
    Done

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Entering Needle Holder and Needle Data in the Mammovision

If the Needle Holder and Needle data are unknown, follow the steps in the **Needle Holder Measuring**, **Entering Needle Holder and Needle Data in the Mammovision, continued**, and **Gun Stroke Measuring** sections below.

1. At the Mammovision screen, select
   Utilities
   Install
2. At the password prompt, enter
   Fischer
3. At the Mammovision screen, select
   Describe Holders
4. At the Needle Holder screen, select the desired holder number.
5. Enter the
   Needle Holder Name
   Needle Holder Length
6. Repeat **step 4** and **step 5** for all the needle holders.
7. Select
   Done
8. Select
   Describe Needles
9. At the Needle Select screen, select the desired needle number.
10. Select the needle holder that is used with this needle.
11. Enter the
    Needle name
    Needle length
    Needle gauge
    Needle Stroke
    Needle Backup (this is a physician preference - consult the responsible party - typically 5mm)
12. Select
    Done
13. Repeat **step 8** to **step 12** for all needles.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Entering Needle Holder and Needle Data in the Mammovision, *continued*

14. Select
    Done
    Done
    Setup
    Select Needle
15. Choose a default needle.
16. Select
    Done
    Done
    Done

Needle Holder Measuring

This procedure assumes that you are sitting directly in front of the needle holder, with the needle pointing to your left.

1. Using a 200 mm precision steel rule, measure between the needle reference point and the depth reference point as shown in the **Sample Needle Holder Reference Points** in the Reference Materials section.

Note The needle holder length is considered positive if the needle reference point is to the left of the depth reference point, and is negative if the needle reference point is to the right of the depth reference point.

2. Record the needle holder data in the **Needle and Needle Holder Data** table.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Entering Needle Holder and Needle Data in the Mammovision, *continued*

Needle Measuring

This procedure assumes that you are sitting directly in front of the needle holder, with the needle pointing to your left.

1. Insert the needle into the needle holder.
2. Using a 200 mm precision steel rule, measure the length of the needle from the needle reference point to the tip of the needle.
3. Record the needle data in the **Needle and Needle Holder Data** table.

Gun Stroke Measuring

Caution	Never cock the biopsy gun while the gun is mounted on the AutoGuide Needle Positioner. Severe damage to the delicate mechanism of the positioner may result.

1. Place the needle in the gun.
2. Cock the gun.
3. Measure from the needle reference point to the tip of the needle.
4. Fire the gun.
5. Measure from the needle reference point to the tip of the needle.Subtract the number in **step 3** from the number in **step 5** to get the gun stroke distance.
6. Record the gun stroke data in the **Needle and Needle Holder Data** table.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Correcting AutoGuide Home Positioning

If the **AutoGuide** has been replaced or subject to mechanical shock, the alignment may have changed. To check alignment, see the Functional Checks section **AutoGuide Functional Checks**.

To fix the AutoGuide positioning, follow the procedure below.

1. Install and connect the AutoGuide in the frontal position.
2. Install the needle guide on the rail.
3. Insert a biopsy needle in the biopsy gun.
4. Place the biopsy gun in the holder.
5. Place the biopsy gun and holder on the AutoGuide rail.
6. Adjust the gun and needle guide to position the needle as far from the camera as possible.
7. Set the AutoGuide positioner to:
   Horizontal: 0°
   Vertical: 6.5°
8. Set the needle depth so that the needle almost touches the carbon fiber plate.
9. If desired, place a piece of thin paper on the carbon fiber plate to protect the surface from the needle.
10. Carefully slide the needle forward until it just touches the carbon fiber plate.
11. Record the H (horizontal), V (vertical), and D (depth) values.
12. Slide the needle guide far enough back that only the tip of the needle will appear in the image.
13. Rotate the x-ray tube to the 0° position.
14. At the Mammovision screen, select:
    Utilities
    Analysis
    Get Images
    Acquire Corrected
    Exposure Control
    Manual
    Store A
15. Select the technique factors:
    25 kV
    100 mA
    10 mAs

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Correcting AutoGuide Home Positioning, *continued*

16. Take a manual exposure.
17. At the Mammovision screen, select
    Done
    Image Analysis
18. Move the cursor to the tip of the needle shown on the image.
19. Record the x-value displayed in the lower right corner of the Mammovision screen.
20. If this value is not 512 ±5,
    a. Move the needle back from the carbon fiber plate.
    b. Manually move the AutoGuide horizontally.
    c. Reset the needle back against the carbon fiber plate.
    d. At the Mammovision screen, select
    Done
    Get Images
    Acquire Corrected
    Store A
    e. At the Mammovision screen, select
    Done
    Image Analysis
    f. Move the cursor to the tip of the needle shown on the image.
    g. Record the x-value displayed in the lower right corner of the Mammovision screen.
    h. Repeat a through g until the value displayed is 512 ±5.
21. Verify that the vertical position of the AutoGuide is parallel to the compression arm. If the table and compression arm are level, a level can be used to check that the AutoGuide is also level.
22. With the AutoGuide in this position, select
    Done
    Done
    Install
23. At the password prompt, type
    fischer

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Correcting AutoGuide Home Positioning, *continued*

24. Select
    Set CCD 0-point
    Target Verify
    Single Point
    Select Needle
25. Enter the appropriate needle and needle holder in the preliminary setup section.
26. Select
    Done
27. Rotate the x-ray tube to the +15° position.
28. Set the generator technique factors to:
    25 kV
    100 mA
    10 mAs
29. Take a manual exposure.
30. Rotate the x-ray tube to the -15° position.
31. Take a second manual exposure.
32. Check the horizontal alignment of the images.
33. If the images do not align, repeat steps 15 through 31 until the horizontal alignment is correct.
34. Mark the needle tip in each image and record the horizontal angle shown on the AutoGuide remote control.
35. Finish calibrating the AutoGuide based on the type of AutoGuide on your system.
    - For a Plus (non-surgical AutoGuide) system follow the **Plus System Calibration** section below.
    - For a Plus/S (surgical AutoGuide) system, follow the **Plus/S System Calibration** section below.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Correcting AutoGuide Home Positioning, *continued*

Plus System Calibration

1. Pull the needle back from the carbon fiber plate.
2. Home the AutoGuide
3. Remove the covers from the bottom of the table.
4. Locate dip switch SW1-7.
5. Set position 7 to ON.
6. Home the AutoGuide.
7. Manually position the AutoGuide horizontally until the value recorded in **step 33** above is displayed on the AutoGuide remote.
8. Verify that "Hold to set HOME" is flashing and that the current motor position is displayed.
9. Continue to hold the "Manual" button down for at least 2 seconds.
10. When the display changes to "New HOME set OK" and the motor position displays "H:0.00 V:0.00," release the "Manual" button.
11. Set position 7 on the dip switch SW1-7 to OFF.
12. Re-install the table covers.
13. Perform the **Targeting Calibration Procedure**.
14. Continue to hold the "Manual" button down for at least 2 seconds.
15. When the display changes to "New HOME set OK" and the motor position displays "H:0.00 V:0.00," release the "Manual" button.
16. Set position 7 on the dip switch SW1-7 to OFF.
17. Re-install the table covers.
18. Perform the **Targeting Calibration Procedure**.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Correcting AutoGuide Home Positioning, *continued*

Plus/S System Calibration

1. Go to the main screen on the AutoGuide.
2. Select
   Service
3. At the Code Display prompt, enter the password
   6800
4. Set the horizontal offset to the value recorded in step 33 above.
5. Perform the **Targeting Calibration Procedure**.

Targeting Calibration Procedure

1. Install and connect the AutoGuide in the frontal position.
2. Install the needle guide on the rail.
3. Insert a biopsy needle in the biopsy gun.
4. Place the biopsy gun in the holder.
5. Place the biopsy gun and holder on the AutoGuide rail.
6. Adjust the gun and needle guide to position the needle as far from the camera as possible.
7. Set the AutoGuide positioner to:
   Horizontal: 0°
   Vertical: 6.39°
8. Set the needle depth so that the needle almost touches the carbon fiber plate.
9. If desired, place a piece of thin paper on the carbon fiber plate to protect the surface from the needle.
10. Carefully slide the needle forward until it just touches the carbon fiber plate.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Targeting Calibration Procedure, *continued*

11. Record the H (horizontal), V (vertical), and D (depth) values.
12. Slide the needle guide far enough back that only the tip of the needle will appear in the image.
13. Rotate the x-ray tube to the 0° position.
14. At the Mammovision screen, select:
    Utilities
    Analysis
    Get Images
    Acquire Corrected
    Exposure Control
    Manual
    Store A
15. Select the technique factors:
    25 kV
    100 mA
    10 mAs
16. Take a manual exposure.
17. At the Mammovision screen, select
    Done
    Image Analysis
18. Move the cursor to the tip of the needle shown on the image.
19. Record the x and y values displayed in the lower right corner of the Mammovision screen.
20. Select
    Done
    Done
    Install
21. At the password prompt, type
    Fischer
22. Select
    CCD 0-point
    Horizontal (X) Position
23. Increment or decrement the value shown to set CCD-X0 to the value of the needle tip (the x value recorded in step 19).
24. Select
    Done
    Vertical (Y) Position

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Targeting Calibration Procedure, *continued*

25. Increment or decrement the value shown to set CCD-X0 to the value of the needle tip (the y value recorded in step 19).
26. Select
    Frontal Trims
27. Set the depth trim to 0.
28. Set the horizontal trim to 0.
29. Set the vertical trim to 0.
30. Select
    Done
    Display Current System Data
31. Verify that parameters CCD-X0, CCD-Y0 and the tolerance adjustments are correct.
32. Select
    OK
33. Move the needle back to the 10 mm position on the positioner rail.
34. Verify that the position of the AutoGuide is at
    Horizontal: 0°
    Vertical: 6.39°
35. Select
    Verify
    Select Needle
36. Enter the appropriate needle and needle holder in the preliminary setup section.
37. Select
    Done
    Grab Images
38. Rotate the x-ray tube to the +15° position.
39. Set the generator technique factors to:
    25 kV
    100 mA
    10 mAs
40. Take a manual exposure.
41. Rotate the x-ray tube to the -15° position.
42. Take a second manual exposure.
43. Click on Image 1 (left image).
44. Click on the tip of the needle in the left image.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Targeting Calibration Procedure, *continued*

45. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown below.

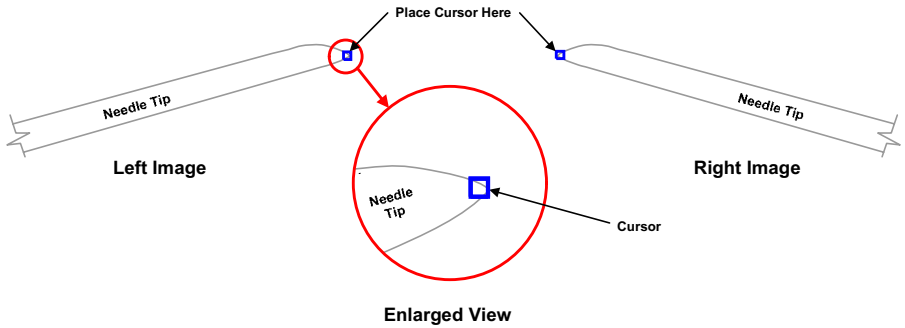


Figure 2: Target Box Positioning

46. Click on Image 2 (right image).
47. Click on the tip of the needle in the right image.
48. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown above.
49. Select
    Show H V Ds
50. Record the displayed values.
51. Calculate the horizontal, vertical and depth trims as follows:
    - Depth Trim =
      (actual setting on rail) - (D value from **step 50**)
    - Horizontal Trim =
      (H angle on AutoGuide) - (H value from **step 50**)
    - Vertical Trim =
      (V angle on AutoGuide) - (H value from **step 50**)
52. Select
    OK
    Done
    Done
    Frontal Trims
53. Set the D Trim to the Depth Trim calculated above (**step 51**).

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Targeting Calibration Procedure, *continued*

54. Select
    Done
    Save Values
    Save Values
    Verify
    Recalculate
55. Verify that the Depth shown on the Mammovision screen corresponds to the depth shown on the AutoGuide.
56. If the values do not match, repeat **step 51** to **step 55** until they do.
57. Select
    OK
    Done
    Frontal Trims
    Leave It Alone
58. Set the H trim to the Horizontal Trim calculated above (**step 51**).
59. Select
    Done
60. Set the V trim to the Vertical Trim calculated above (**step 51**).
61. Select
    Done
    Verify
    Recalculate.
62. Verify that the Depth shown on the Mammovision screen corresponds to the depth shown on the AutoGuide.
63. If the values do not match, repeat **step 51** to **step 62** until they do.
64. Select
    OK
    Done
65. Record the trim values when calibration is complete.

Mammotest/Mammovision Alignment and Calibration, *continued*

CF Distance Calibration Procedure

1. Check that the gun is cocked and that the needle data is correct.
2. Move the needle so it just touches the carbon fiber plate.
3. Select
   Verify
   Grab Images
4. Set the generator technique factors to:
   25 kV
   100 mA
   10 mAs
5. Rotate the x-ray tube to the +15° position.
6. Make a manual exposure.
7. Rotate the x-ray tube to the -15° position.
8. Make a manual exposure.
9. Click on the tip of the needle in the left image.
10. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown in figure x.
11. Click on the tip of the needle in the right image.
12. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown in figure x.
13. Move the needle at least 3 cm away from the carbon fiber plate.
14. Fire the gun.
15. Move the needle forward until it just touches the carbon fiber plate.
16. Record the depth reading as "Actual Distance to the Carbon Fiber Plate."
17. Calculate the sum of (ADJ D) + (ADJ SM).
18. If the depth reading from **step 16** does not match the sum from **step 17**, calculate the difference between the two values.
19. Select
    Edit System Data

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

CF Distance Calibration Procedure, *continued*

20. Modify the "CF to Phosphor" value as follows:
    - if the difference is positive, subtract the difference from the CF default of 3mm.
    - if the difference is negative, add the difference to the CF default of 3 mm.
21. At the Mammovision screen, select
    Done
    Verify
    Recalculate
22. Verify that the ADJ D value now agrees with the "Actual Distance to the Carbon Fiber Plate."
23. Select
    OK
    Done

Left Side Lateral Approach Trim Angle Calibration Procedure

1. At the Mammovision screen, select
   OK
   Done
   Edit System Data
2. Change the Wx value to 310.0.
3. Select
   Done
   Verify
4. Attach the lateral arm to the patient left side of the table.
5. Install a lateral approach needle guide with a 16 cm needle on the AutoGuide.
6. Install the AutoGuide on the lateral arm.
7. Plug the AutoGuide into the left side connector.
8. Click on "Lateral Approach" and verify that the lateral approach icon is selected (dark).
9. Verify that "Patient Left" is displayed.

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Left Side Lateral Approach Trim Angle Calibration Procedure, *continued*

10. Pull the needle and needle guide away from the camera.
11. Home the AutoGuide.
12. Position the needle at
    Horizontal: -1°
    Vertical: 4°
    Depth: approx. 165 mm
13. At the Mammovision screen, select
    Verify
    Select Needle
14. Enter the appropriate needle and needle holder in the preliminary setup section.
15. Select
    Done
    Grab Images
16. Rotate the x-ray tube to the +15° position.
17. Set the generator technique factors to:
    25 kV
    100 mA
    10 mAs
18. Take a manual exposure.
19. Rotate the x-ray tube to the -15° position.
20. Take a second manual exposure.
21. Click on Image 1 (left image).
22. Click on the tip of the needle in the left image.
23. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown in the **Target Box Positioning** illustration.
24. Click on Image 2 (right image).
25. Click on the tip of the needle in the right image.
26. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown in the **Target Box Positioning** illustration.
27. Select
    Show H V Ds
28. Calculate the Depth Trim [(actual setting on rail) - (value from Mammovision screen)]

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Left Side Lateral Approach Trim Angle Calibration Procedure, *continued*

29. Select
    OK
    Done
    Done
    Patient's Left Lateral Trims
30. Set the calculated depth trim from **step 28**.
31. Select
    Done
    Save Values
    Save Values
    Verify
    Recalculate
32. Repeat **step 28** to **step 31** until the depth on the Mammovision screen matches the actual depth.
33. Calculate the H trim.
34. Calculate the V trim.
35. At the Mammovision screen, select
    OK
    Done
    Done
    Patient's Left Lateral Trims
    Leave It Alone (for the D trim)
36. Set the H trim value to that calculated in **step 33**.
37. Select
    Done
38. Set the V trim value to that calculated in **step 34**.
39. Select
    Done
    Verify
    Recalculate
40. Repeat **step 33** to **step 39** until the calculated H and V angles are equal to the actual H and V angles.
41. Select
    OK
    Done

Mammotest/Mammovision Alignment and Calibration, *continued*

Right Side Lateral Approach Trim Angle Calibration Procedure

1. Attach the lateral arm to the patient right side of the table.
2. Install a lateral approach needle guide with a 16 cm needle on the AutoGuide.
3. Install the AutoGuide on the lateral arm.
4. Plug the AutoGuide into the right side connector.
5. Click on "Lateral Approach" and verify that the lateral approach icon is selected (dark).
6. Verify that "Patient Left" is displayed.
7. Pull the needle and needle guide away from the camera.
8. Home the AutoGuide.
9. Position the needle at
   Horizontal: 1°
   Vertical: 4°
   Depth: approx. 165 mm
10. At the Mammovision screen, select
    Verify
    Select Needle
11. Enter the appropriate needle and needle holder in the preliminary setup section.
12. Select
    Done
    Grab Images
13. Rotate the x-ray tube to the +15° position.
14. Set the generator technique factors to:
    25 kV
    100 mA
    10 mAs
15. Take a manual exposure.
16. Rotate the x-ray tube to the -15° position.
17. Take a second manual exposure.
18. Click on Image 1 (left image).
19. Click on the tip of the needle in the left image.
20. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown in the **Target Box Positioning** illustration.
21. Click on Image 2 (right image).

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Right Side Lateral Approach Trim Angle Calibration Procedure, *continued*

22. Click on the tip of the needle in the right image.
23. Use the arrow keys on the keyboard to move the target box so that it is positioned over the needle tip as shown in **Target Box Positioning**.
24. Select
    Show H V Ds
25. Calculate the Depth Trim [(actual setting on rail) - (value from Mammovision screen)]
26. Select
    OK
    Done
    Done
    Patient's Right Lateral Trims
27. Set the calculated depth trim from **step 25**.
28. Select
    Done
    Save Values
    Save Values
    Verify
    Recalculate
29. Repeat **step 25** to **step 28** until the depth on the Mammovision screen matches the actual depth.
30. Calculate the H trim.
31. Calculate the V trim.
32. At the Mammovision screen, select
    OK
    Done
    Done
    Patient's Right Lateral Trims
    Leave It Alone (for the D trim)
33. Set the H trim value to that calculated in **step 30**.
34. Select
    Done
35. Set the V trim value to that calculated in **step 31**.
36. Select
    Done
    Verify
    Recalculate

Continued on next page

Mammotest/Mammovision Alignment and Calibration, *continued*

Right Side Lateral Approach Trim Angle Calibration Procedure, *continued*

37. Repeat **step 30** to **step 36** unitil the calculated H and V angles are equal to the actual H and V angles.

38. Select
    OK
    Done
    Done

COMPONENT LOCATIONS

Fischer Athena Mammovision Overview

Athena System
- Athena System Overview
- Athena System Collimator and X-Ray Tube

Athena Generator Component Locations
- Athena Generator
- Control Panel
- CPU Board and AEC Board
- Two Tube Display Board
- Tubehead I/O Board
- Power Panel
- X-Ray Control Boards and High Tension Transformer
- Optical SCR Trigger

Mammovision/Mammotest System Component Locations
- Mammotest Table
- X-Ray Arm Overview
- Removing the Collimator Cover
- X-Ray Tube and Collimator
- Inside the Collimator
- AutoGuide and Needle Holder with Needle
- Compression Paddle Adjustment
- CCD Camera Board
- Table Control Boards
- Table Controls

Fischer Athena Mammovision Overview

Mammotest Table

Athena Generator

Mammovision System

Athena C-Arm

Athena System

Athena System Overview

Athena System

Athena C-Arm

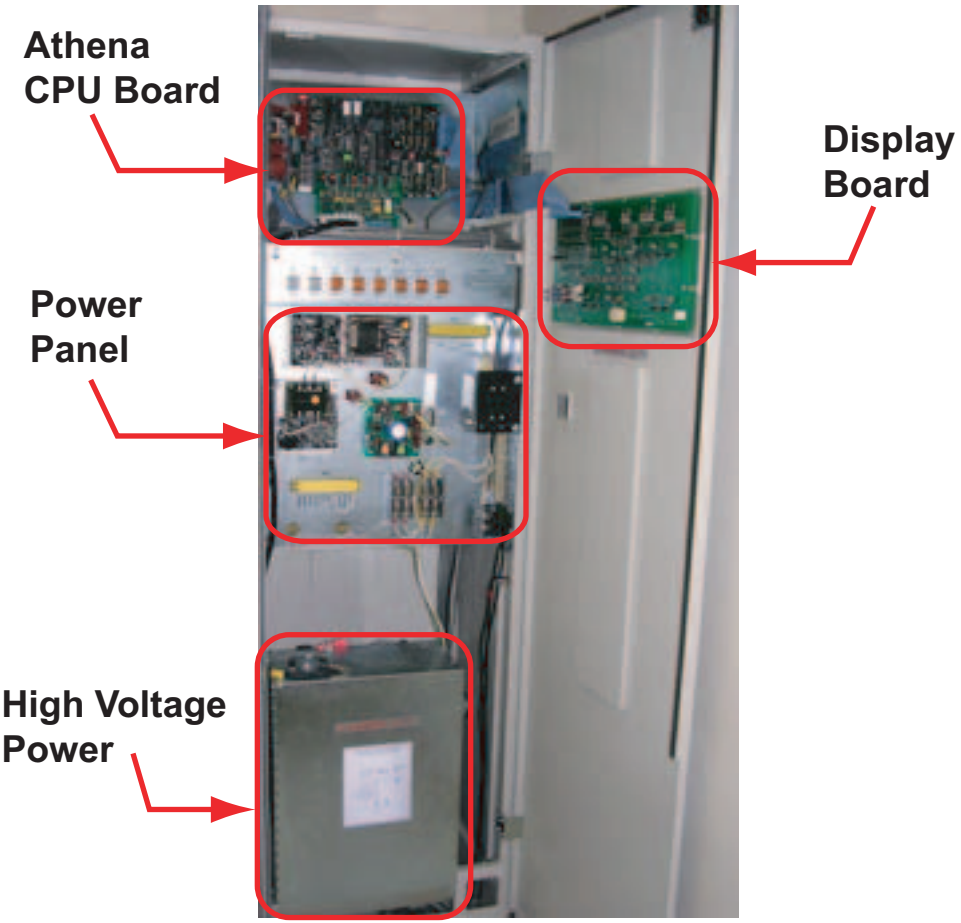
Athena System, *continued*

Athena System Collimator and X-Ray Tube

Athena Generator Component Locations

Athena Generator

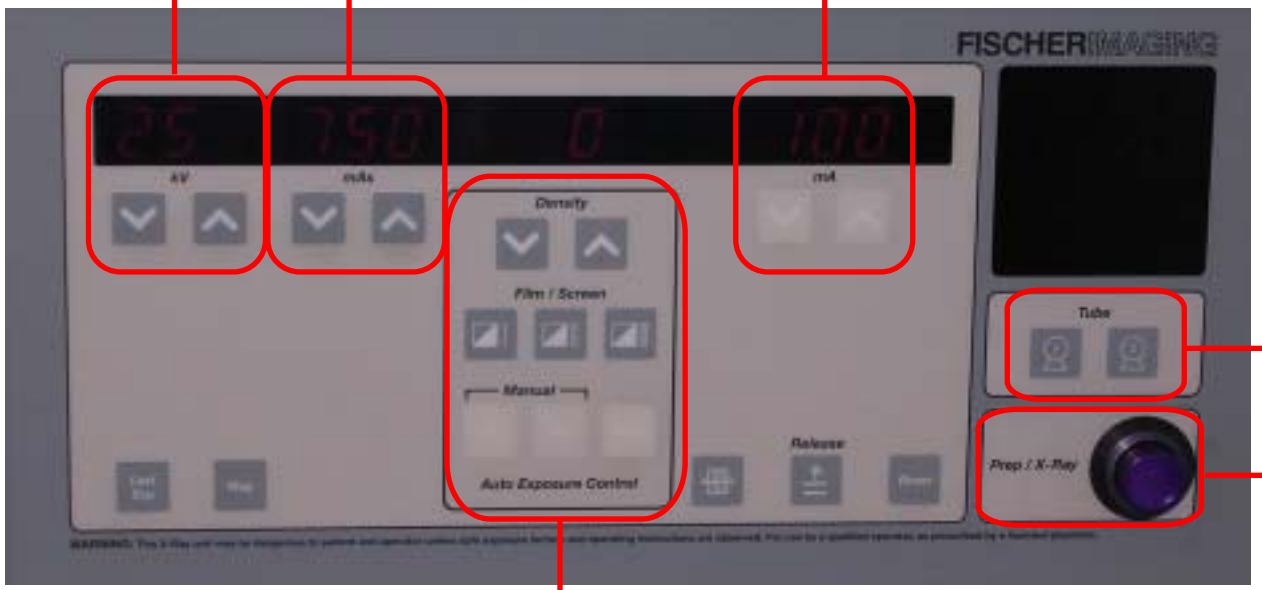
Front Panel Closed



Front Panel Open

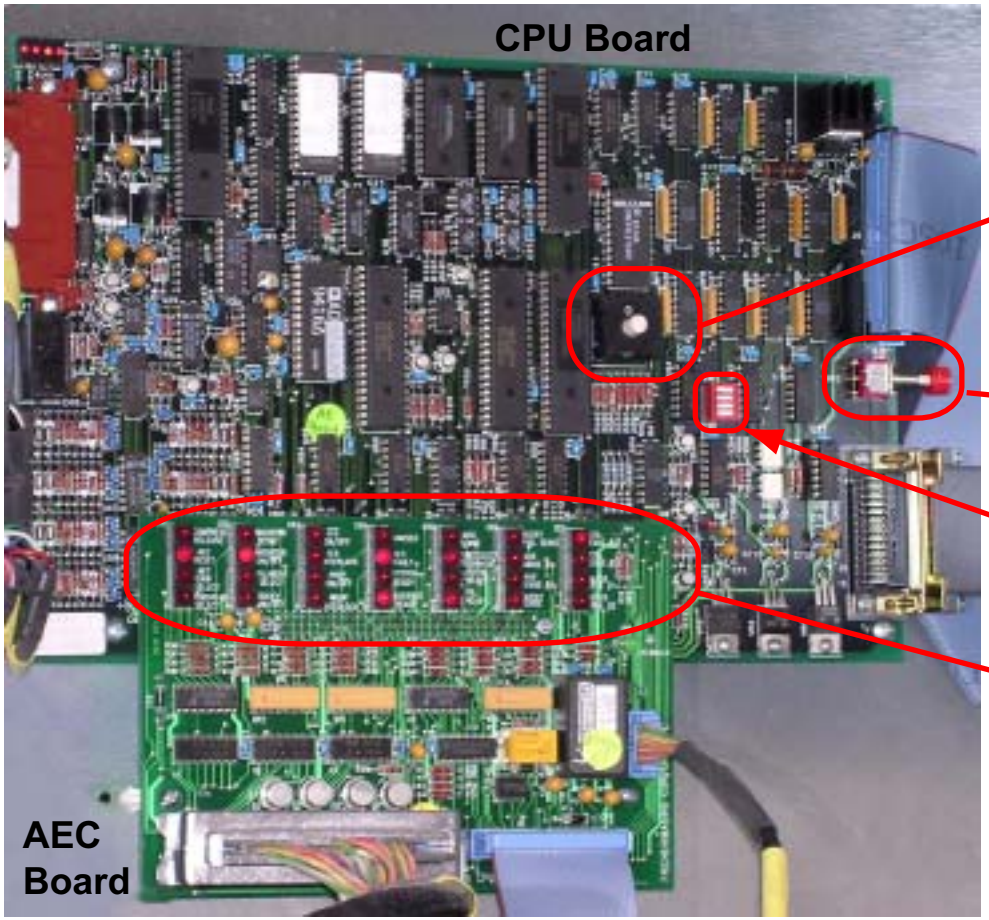
Athena Generator Component Locations, *continued*

Control Panel

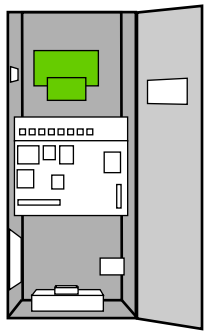


Athena Generator Component Locations, *continued*

CPU Board and AEC Board



SW1



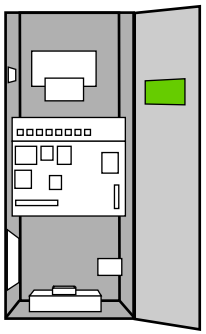
SW2

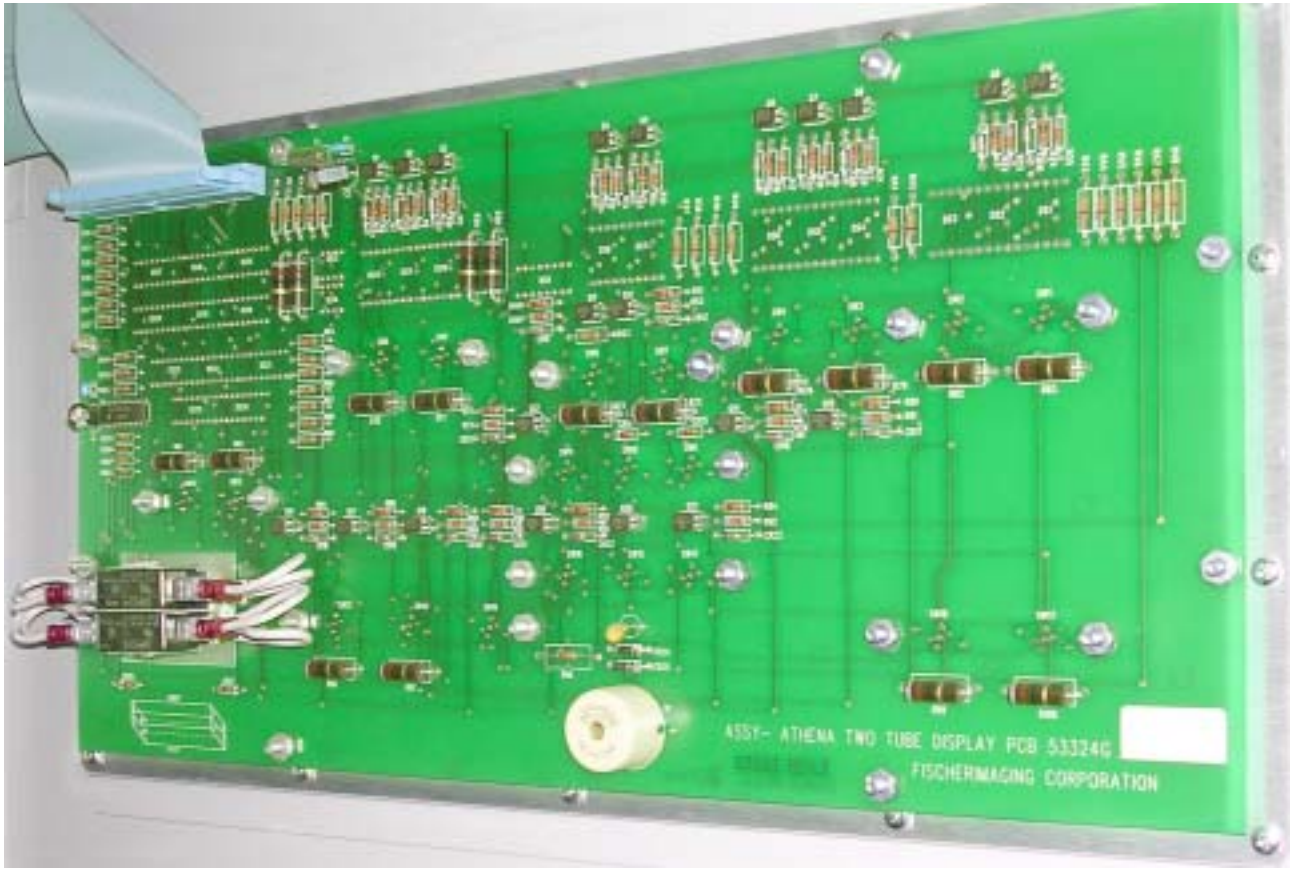
SW3

Status LEDs

Athena Generator Component Locations, *continued*

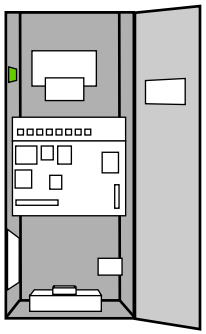
Two Tube Display Board





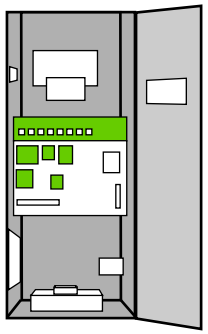
Athena Generator Component Locations, *continued*

Tubehead I/O Board



Athena Generator Component Locations, *continued*

Power Panel



Fuse Panel

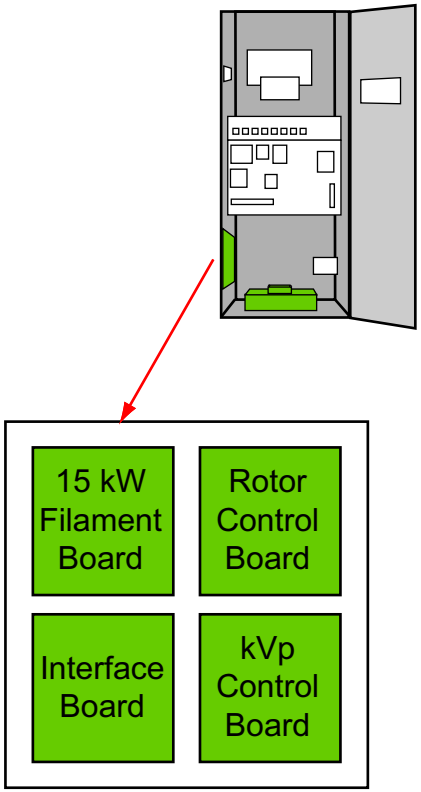
±15V and
+ 5 V power

+24V Unregulated Power

+24V
Regulated
Power

Athena Generator Component Locations, *continued*

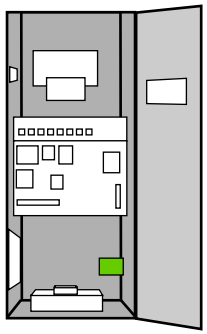
X-Ray Control Boards and High Tension Transformer



High Voltage Tank

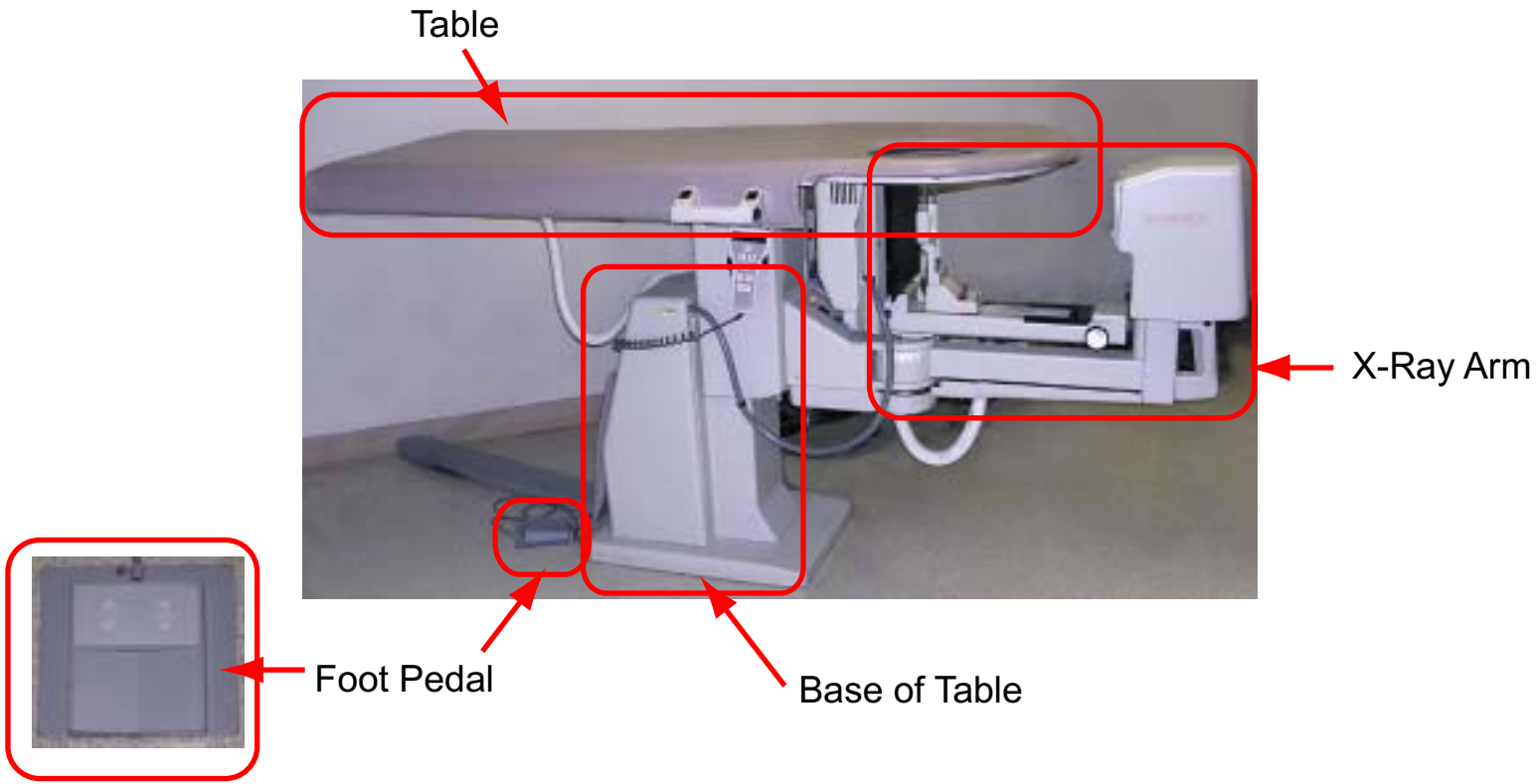
Athena Generator Component Locations, *continued*

Optical SCR Trigger



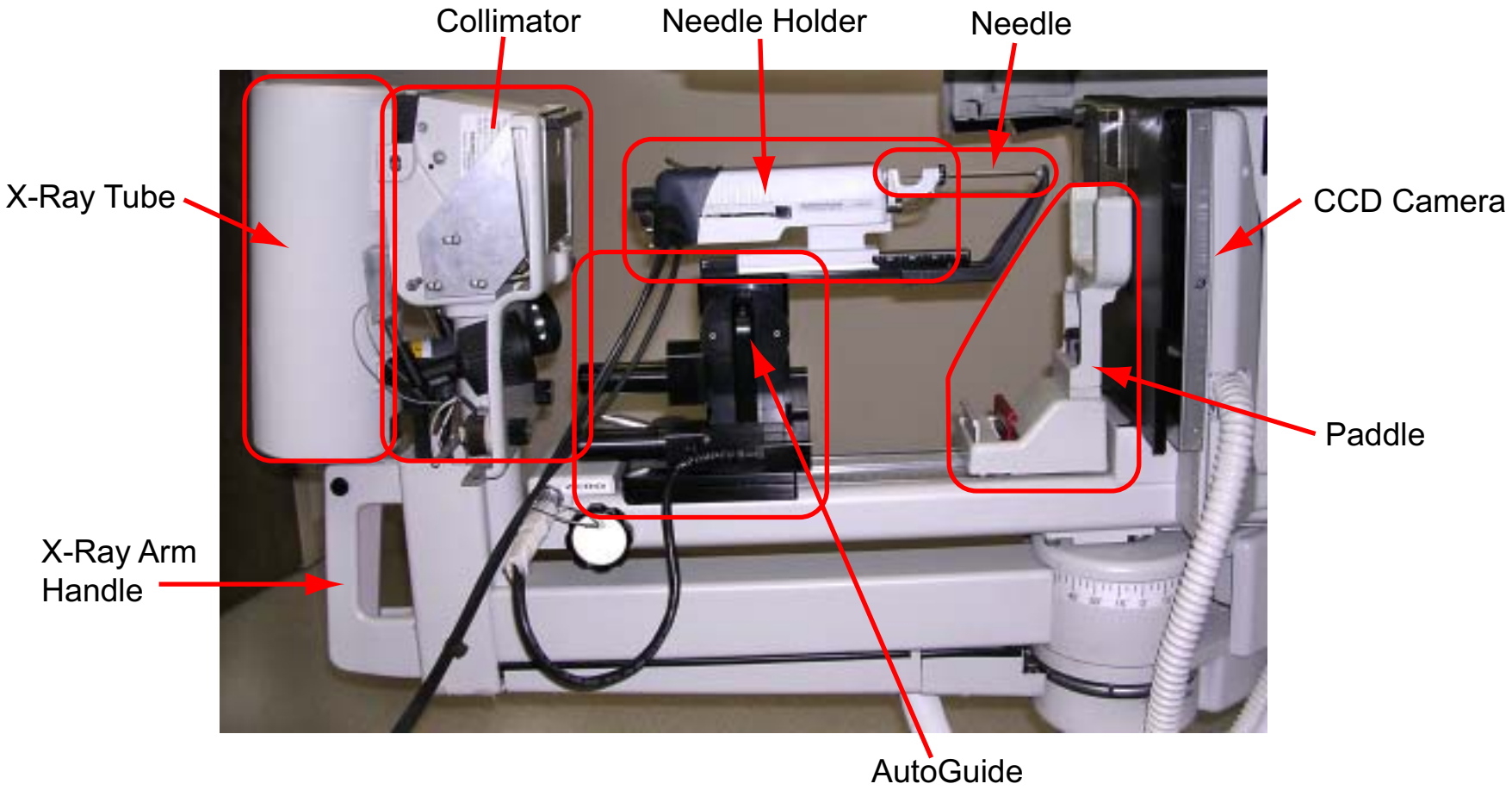
Mammovision/Mammotest System Component Locations

Mammotest Table



Mammovision/Mammotest System Component Locations, *continued*

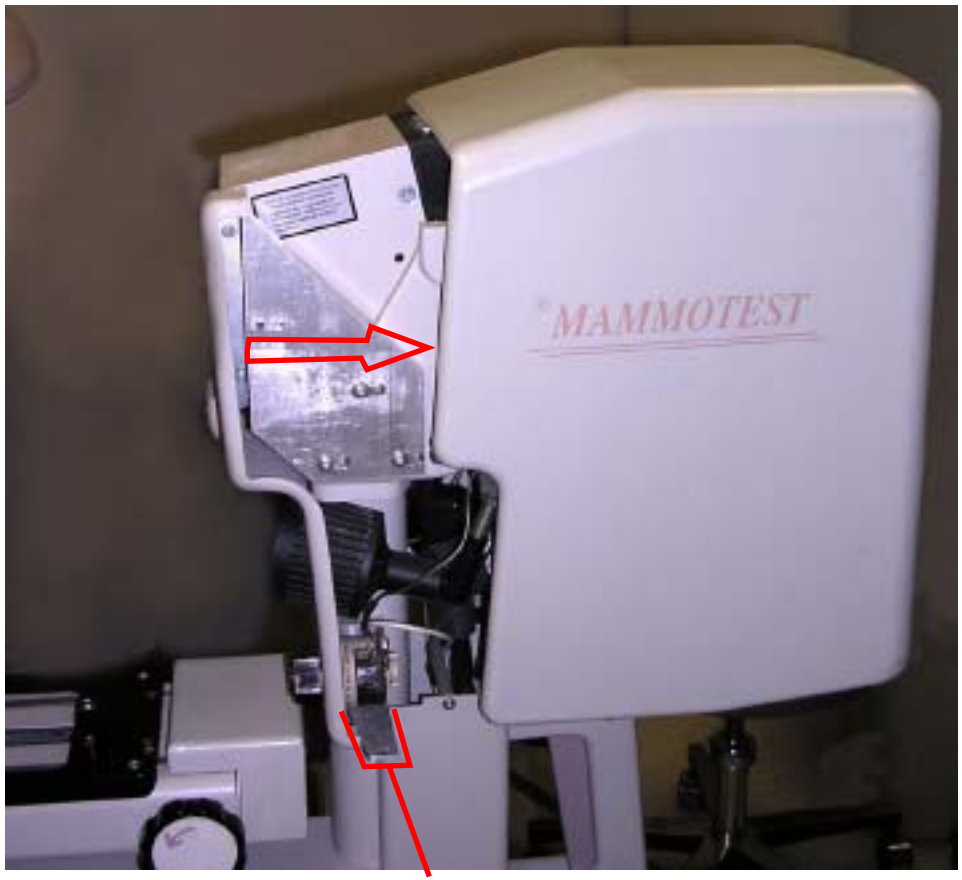
X-Ray Arm Overview



Mammovision/Mammotest System Component Locations, *continued*

Removing the Collimator Cover

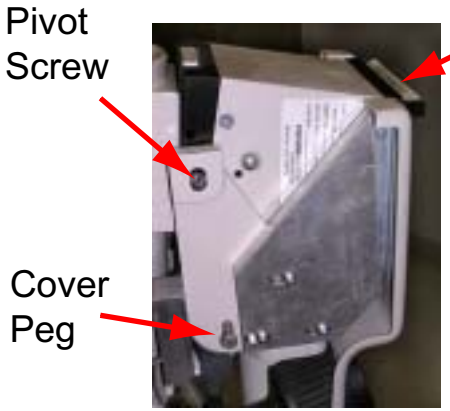
Remove Collimator cover by stretching bottom of cover over cover bracket, then pulling up and back until the cover slides over the collimator and x-ray tube.

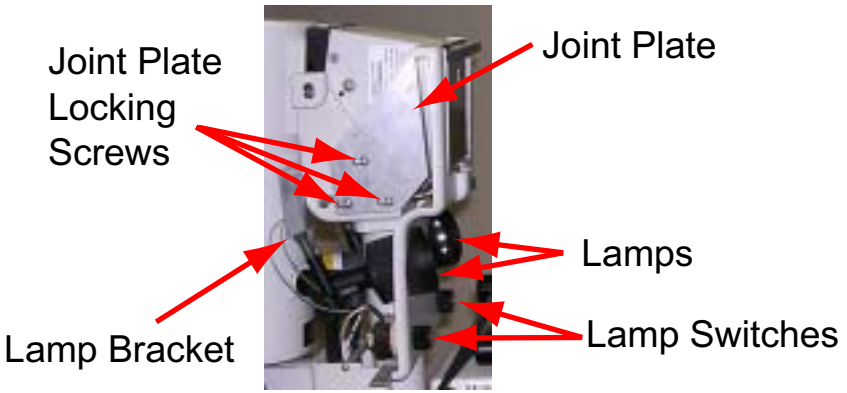


Cover Bracket

Mammovision/Mammotest System Component Locations, *continued*

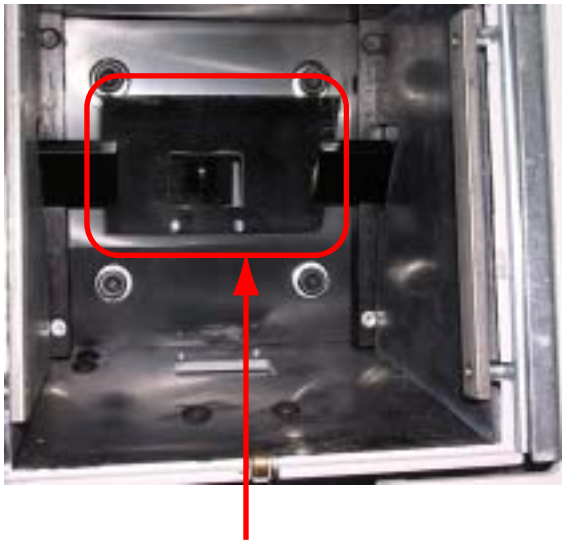
X-Ray Tube and Collimator





Mammovision/Mammotest System Component Locations, *continued*

Inside the Collimator



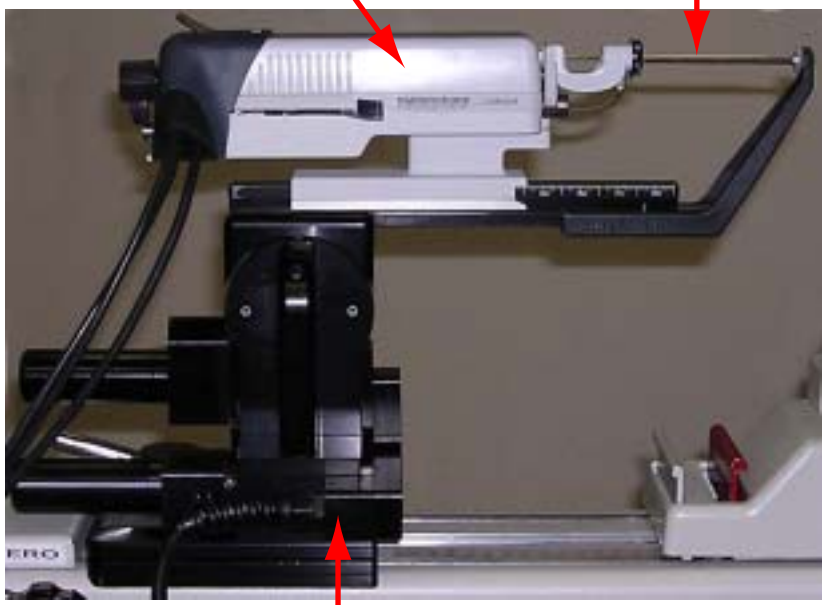
Collimator Mirror
(aperature removed)

Mirror Pivot Screw

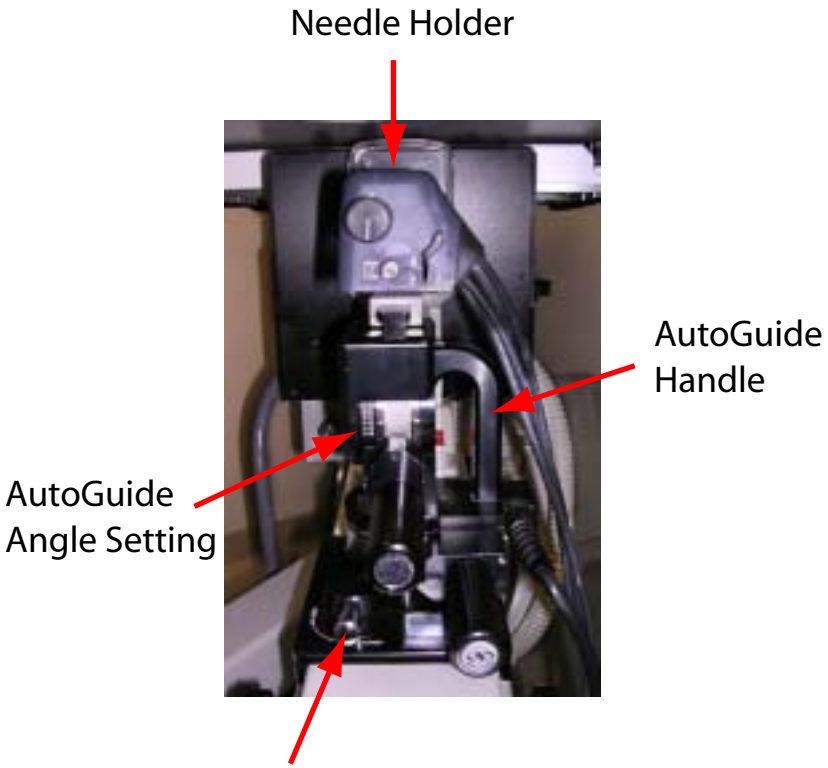
Mirror Set Screw

Mammovision/Mammotest System Component Locations, *continued*

AutoGuide and Needle Holder with Needle



Side View



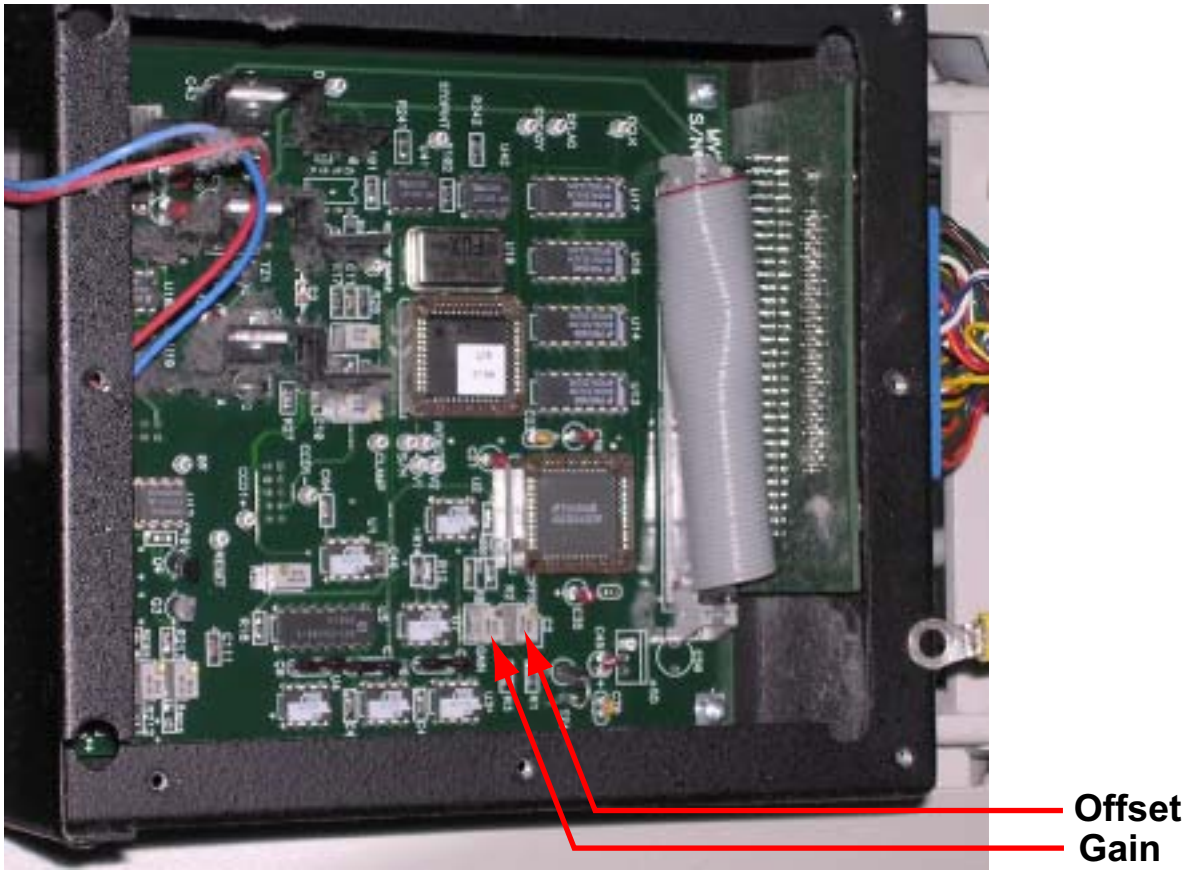
Rear View

Mammovision/Mammotest System Component Locations, *continued*

Compression Paddle Adjustment

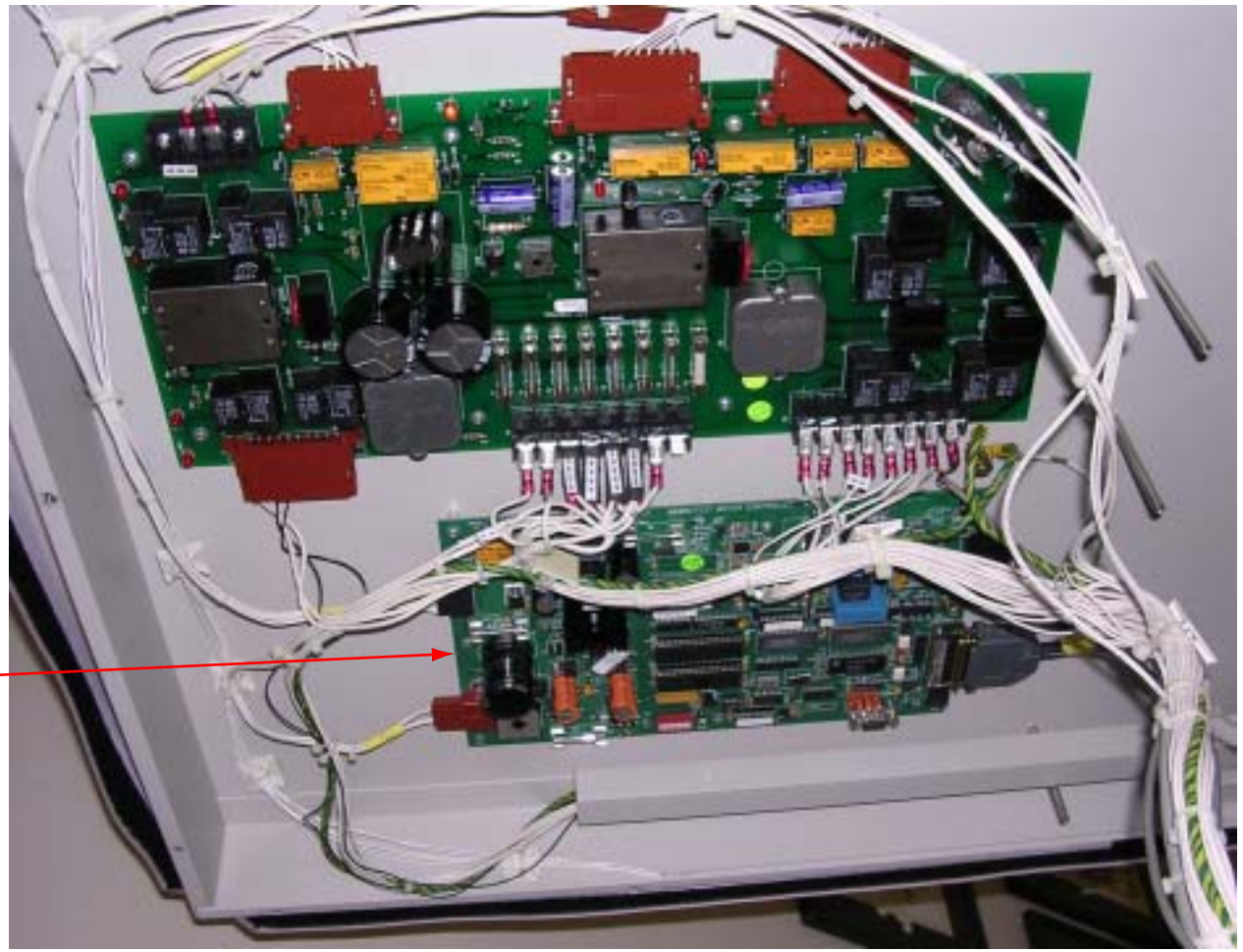
Mammovision/Mammotest System Component Locations, *continued*

CCD Camera Board



Mammovision/Mammotest System Component Locations, *continued*

Table Control Boards



Mammovision/Mammotest System Component Locations, *continued*

Table Controls

AutoGuide

Table Control Handle

Up/Down
Motion Control

Longitudinal
Motion Control

X-Ray Arm Control Handle

Camera Arm
Lock/Release

X-Ray Arm
Lock/Release

Foot Pedal

Error Codes

Athena HF Generator and System Error Codes
Mammovision/Mammotest System Error Codes
- Non Surgical AutoGuide Error Codes
- Surgical AutoGuide Error Codes
- Mammovision Error Codes Displayed on the Generator
- Mammovision Error Codes Displayed on the Monitor

Athena HF Generator and System Error Codes

Table 6: Error Code Summary

Error Code	Description
E10 - E17	Nonvolatile RAM checksum error
E18	Incorrect A/D reference voltages
E19	Internal software problem
E21	Low/no filament current
E22	Rotor Control Board Error
E23	KVP control board error
E24	Grid can't find home error
E25	mAs backup timer error
E26	slow mAs
E27	tube current overload
E31	Filament control board power problem

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E10	**Nonvolatile RAM Checksum** The checksum stored in nonvolatile RAM does not match the checksum calculated directly from the data	• a high voltage problem disrupted CPU operations • the nonvolatile memory IC on the CPU board is bad • the CPU board is bad	• Check for high voltage problems • Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board** • Verify that the high tension transformer is completely full of oil (no air gap)
E11	**Nonvolatile RAM Checksum Error** The recalculated checksum, based on data gathered after re-initilization, does not match the checksum stored in nonvolatile RAM.	• Nonvolatile memory IC on CPU board is bad • CPU Board is bad	• Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board**
E12	**Nonvolatile RAM Checksum Error** No acknowledgment of a nonvolatile write command was received	• nonvolatile memory IC on CPU board is bad	• Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board**

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E13	**Nonvolatile RAM Checksum Error** No acknowledgment of a nonvolatile write address was received	• nonvolatile memory IC on CPU board is bad	• Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board**
E14	**Nonvolatile RAM Checksum Error** No acknowledgment of nonvolatile write data was received	• nonvolatile memory IC on CPU board is bad	• Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board**
E15	**Nonvolatile RAM Checksum Error** No acknowledgment of a nonvolatile read command was received	• nonvolatile memory IC on CPU board is bad	• Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board**
E16	**Nonvolatile RAM Checksum Error** No acknowledgment of a nonvolatile read address was received	• nonvolatile memory IC on CPU board is bad	• Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board**

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E17	**Nonvolatile RAM Checksum Error** No acknowledgment of a nonvolatile read data was received	• nonvolatile memory IC on CPU board is bad	• Replace the nonvolatile memory IC on the CPU board • Replace the **CPU Board**
E18	**A/D reference voltages are incorrect** The fixed voltage from either the ±15 VDC supply or the analog reference is incorrect.	• absence of +15 VDC • absence of -15 VDC • absence of +10 VDC analog reference voltage generated by the A/D converter • faulty op-amp buffering test voltages • faulty analog multiplexer • faulty A/D converter	• Check all fuses and replace bad ones • Check power supply voltages and replace power supply if defective • Replace A/D converter • Replace the **CPU Board** • Replace the analog multiplexer chip
E19	**Internal software problem** Read attempt made on an illegal nonvolatile RAM address	• defective software	• Notify the factory and replace software

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E21	**Low/No Filament Current** The CPU has sensed an error on the **Filament control board**. As a consequence, the power is removed from the following: • H.V. interface board • KVP control board • Rotor control board. To restore power to these boards, a. Turn SW1 to position 1 (calibration) b. Press "Reset" c. Press SW2 repeatedly until power is restored. If the CR3 (+15 V) and CR4 (-15 V) LEDs on the HV interface board are lit, power has been restored.	• Bad connections between the filament control board and the tube filaments • Bad filament control board • A high voltage problem that disrupted filament current measurement circuitry • Broken tube filaments • Fuse blown on filament control board • +300 V missing between the filament fuses F1 and F2	• Check if both small and large filaments are affected. • Check filament resistance. Large filament = ~0.2 - 0.4 Ohms Small filament = ~0.7 to 1.1 Ohms • Check the following status LEDs: – CR35 Undercurrent: If this is not lit, check the mA boost calibration. – CR36 Overcurrent: If this is not lit, check the both fuses on the filament control board. Also verify that +300 VDC is present at both fuses. Select "Test" on the kV control board, and observe the pulses between TP3 and TP4 on the kV control board with an oscilloscope If pulses are irregular or missing, replace the board. – If the CR36 Overcurrent LED is off, replace the board – If none of the above LEDs are off, but error E21 remains, check the CPU I/O and the interface boards.

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E22	**Rotor Control Board Error** The CPU sensed an error on the **Rotor control board**	• Fuse blown on rotor control board • Rotor voltage too high - adjust to 60V running • Rotor voltage too low - adjust to 60V running • Phase capacitor problem	• Verify that the phase capacitor connectors are clear • Check power connections and ribbon cables • Check high voltage connections • If the CR37 Rotor Fault LED is lit, replace the rotor control board. • Press "Prep" and check that the CR14 Boost LED is lit for 1 second, then the CR4 (on the rotor control board) and the CR5 (on the CPU board) LEDs are lit. If the CR4 LED does not light, connect a true RMS DVM between F2 to the anode of CR29. If, when "Prep" is pressed, 228V AC (for 1 sec.), then 60 VRMS does not occur, replace the rotor control board. • If none of these LEDs are off, but error E22 remains, check the CPU I/O and the interface boards.

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E23	**kVp Control Board Error**	• Over-voltage trip • Failed ±15 V power supply • kV voltage rising too slowly • Continuity loss on the kV and mA feedback lines • 55 Amp fuse failure • SCR Trigger board failure • High Voltage transformer failure	• Check all board connections and high voltage connections • Check that LEDs CR40 (Window), CR46 (kV Max), and CR44 (Primary Overcurrent) are lit. • If CR40 (Window) LED is off, check the following: – Check the mA boost calibration – Check the 55Amp fuse (located near the SCR Trigger boards) – Check that the voltage between CR1 and CR2 is 340 V – Verify that the kV waveform is without high voltage arcs, using an oscilloscope in storage mode at J2. – Replace the kVp control board.

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E23 (cont.)			• If the CR46 (kV Max) LED is off, check the following: – Check the kV feedback. The feedback voltage should be 1 V per 10V of the selected kV. – Verify that the kV waveform is without high voltage arcs, using an oscilloscope in storage mode at J6. • If the CR44 (Overcurrent) LED is off, check the following: – Verify that the kV waveform is without high voltage arcs, using an oscilloscope in storage mode at J2. – Check the primary current waveform from the HV transformer. Verify that the peak current is between 170 and 200 amps. If current is high, check the HV transformer • Replace the kVp control board. • If none of these LEDs are off, but error E23 remains, check the CPU I/O and the interface boards.

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E24	**Bucky Error** There is no cassette in the **Bucky**, or the cassette has been already used.	• Bucky malfunction • CPU I/O board failure	• Check the signal at the CPU I/O board
E25	**mAs Backup Timer Error** The CPU did not measure any significant mA for a 100 ms interval during an exposure.	• Filament broke during exposure - see also error E21 • mA measurement circuit on filament control board may be faulty • CPU board circuit receiving mA pulses may be faulty • Faulty ground connection to high voltage transformer mA terminal via the filament control board. Faulty ground may also cause spark gap on high voltage transformer to discharge when safety contactor is engaged or exposure starts. • Filament calibration is low. See also error E21.	• Check the calibration data numbers. • Measure the resistance of the tube filaments to ensure that they are not broken. • Verify that the x-ray tube connections are properly made and the ground is securely connected. • Measure the mA on the filament control board and check that it matches the mA selected. • Check for a pulse output of the filament control board during an exposure.

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E26	**Slow mAs** The calculated exposure time has been exceeded by at least 25%.	• The generator is putting out too little mA, resulting in longer exposures than specified. • mA measurement circuit on the filament control board is faulty • Tube's mA output is reduced because of faulty grounding of the tube housing resulting in a buildup of charge on the tube housing • mA output of tube is reduced because of faulty grounding of the filament common, which results in buildup of charge on the cathode	• Check the calibration data numbers. • Measure the mA on the **Filament control board** and check that it matches the mA selected. • Check the x-ray tube and ground connections.
E27	**Tube Current Overload** Excessive tube current tripped the tube current overload circuit on the filament control board.	• A prolonged tube arc created an excessive amount of tube current • The generator is out of calibration	• Check the mA waveform and other indicators of high voltage problems. • Check the calibration data numbers.
E31	**AEC Detector Problem** The CPU does not detect the AEC signal increasing.	• Very dense breast tissue • Detector failure • The detector locked up because of a high voltage arc	• Power down and back up to clear detector lockup • Step up kV to increase detector response • Replace the **AEC pre-amp board**

Continued on next page

Athena HF Generator and System Error Codes, *continued*

Error#	Description	Possible Causes	Diagnostic Checks
E45	**Heat Unit Overload** The CPU has sensed that the temperature of the x-ray tube housing is too high.		• Let the tube cool off before re-attempting another exposure
E50	**AEC Time-out Error**		• Check the AEC pre-amp board.
E51	**AEC Detector Problem** The AEC has exceeded the dynamic range of the AEC radiation measurement circuit. The film will usually be clinically useful despite the AEC problem.	• kV selection is too low • Very dense breast tissue • Detector failure • The detector locked up because of a high voltage arc	• Power down and back up to clear detector lockup • Step up kV to increase detector response • Replace the **AEC pre-amp board**
E52	**Door Interlock Problem**	• The door interlock switch has been opened.	

Mammovision/Mammotest System Error Codes

Non Surgical AutoGuide Error Codes

Error Number	Error Code	Definition	Cause/Corrective Action
ERR10	H_ILMT_ERR	Horizontal current limit	Check for mechanical binding of the positioner or electrical short in the cabling or electronics
ERR11	H_MC_CMD_ERR	Horizontal LM629 command error	8032 Microprocessor lost communications with the LM629 motor controller. Check motor control board.
ERR12	H_EPOS_ERR	Horizontal excessive position error	The motor cannot position correctly, as it is lagging behind. Check the motor supply voltage, mechanical binding in the positioner and encoder feedback from the motor.
ERR13	H_STATE_ERR	Horizontal state error	Software state error. Check the motor control board.
ERR14	H_MX_HWLMT_ERR	Horizontal hardware positive limit error	The hardware travel limit switch has been tripped. If the positioner is at the mechanical limit, check the following: • Check the home positioning • Check the motor control board If the positioner is not at a mechanical limit, check: • Limit sensor wiring • Motor control board limit switch logic • Motor control board +5 ENC supply • Motor control board fuse
ERR15	H_MX_HWLMT_ERR	Horizontal hardware negative limit error	

Mammovision/Mammotest System Error Codes, *continued*

Non-Surgical AutoGuide Error Codes, *continued*

Error Number	Error Code	Definition	Cause/Corrective Action
ERR16	H_EWRAP_ERR	Horizontal ewrap error	Replace the motor control board. The LM629 motor controller reported a wraparound error - the encoder position has overflowed its maximum size.
ERR17	H_MC_IO_ERR	Horizontal LM629 I/O error	Replace the motor control board. The LM629 cannot communicate with the 8032 microprocessor.
ERR18	H_DEST_ERR	Horizontal destination error	The horizontal motor did not reach the final position correctly. Check for mechanical problems or replace the motor control board.
ERR19	H_CMD_ERR	Horizontal illegal MCMD	Replace the motor control board. The LM629 cannot communicate with the 8032 microprocessor.
ERR20	H_RNGE_ERR	Horizontal range error	The destination position is outside the AutoGuide allowable range. Typically due to a software error. Check the Mammovision system.
ERR21	HORIZ_HM_INDEX	Horizontal home index error	The horizontal home sensor could not be found. Check the home sensor in the positioner, the wiring, or the motor control board home sensor circuits.
ERR30	V_ILMT_ERR	Vertical current limit	Check for mechanical binding of the positioner or electrical short in the cabling or electronics

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Mammovision/Mammotest System Error Codes, *continued*

Non-Surgical AutoGuide Error Codes, *continued*

Error Number	Error Code	Definition	Cause/Corrective Action
ERR31	V_MC_CMD_ERR	Vertical LM629 command error	8032 Microprocessor lost communications with the LM629 motor controller. Check motor control board.
ERR32	V_EPOS_ERR	Vertical excessive position error	The motor cannot position correctly, as it is lagging behind. Check the motor supply voltage, mechanical binding in the positioner and encoder feedback from the motor.
ERR33	V_STATE_ERR	Vertical state error	Software state error. Check the motor control board.
ERR34	V_MX_HWLMT_ERR	Vertical hardware positive limit error	The hardware travel limit switch has been tripped. If the positioner is at the mechanical limit, check the following: • Check the home positioning • Check the motor control board If the positioner is not at a mechanical limit, check: • Limit sensor wiring • Motor control board limit switch logic • Motor control board +5 ENC supply • Motor control board fuse
ERR35	V_MN_HWLMT_ERR	Vertical hardware negative limit error	

Continued on next page

Mammovision/Mammotest System Error Codes, *continued*

Non-Surgical AutoGuide Error Codes, *continued*

Error Number	Error Code	Definition	Cause/Corrective Action
ERR36	V_EWRAP_ERR	Vertical ewrap error	Replace the motor control board. The LM629 motor controller reported a wraparound error - the encoder position has overflowed its maximum size.
ERR37	V_MC_IO_ERR	Vertical LM629 I/O error	Replace the motor control board. The LM629 cannot communicate with the 8032 microprocessor.
ERR38	V_DEST_ERR	Vertical destination error	The vertical motor did not reach the final position correctly. Check for mechanical problems or replace the motor control board.
ERR39	V_CMD_ERR	Vertical illegal MCMD	Replace the motor control board. The LM629 cannot communicate with the 8032 microprocessor.
ERR40	V_RNGE_ERR	Vertical range error	The destination position is outside the AutoGuide allowable range. Typically due to a software error. Check the Mammovision system.
ERR41	HORIZ_HM_INDEX	Vertical home index error	The vertical home sensor could not be found. Check the home sensor in the positioner, the wiring, or the motor control board home sensor circuits.

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Mammovision/Mammotest System Error Codes, *continued*

Non-Surgical AutoGuide Error Codes, *continued*

Error Number	Error Code	Definition	Cause/Corrective Action
ERR50	CON_TMOUT_ERR	Console communication timeout error	The AutoGuide system and Mammovision computer are having trouble communicating. Check the cabling and interface circuits for proper connections, shielding and grounding.
ERR51	CON_CMD_ERR	Unknown console command error	
ERR52	CON_CHKSUM_ERR	Console checksum error	
ERR53	CON_LNKTST_ERR	Console linktest error	
ERR54	CON_RSP_ERR	Unexpected console response error	
ERR60	ORG_SEEK_ERR	Origin seek error	The home origin sensor is faulty. Check the sensor circuits, cabling and positioner.
ERR61	TARG_RNGE_ERR	Target range error	The target position is outside the allowable range of the AutoGuide. Check communication between the Mammovision and AutoGuide or check the Mammovision system.
ERR62	RELAY_FAULT_ERR	Relay fault	The motion enable relay has a problem - eg. it may be stuck ON or OFF. Check the motion enable circuits or replace the motor control board.

Continued on next page

Mammovision/Mammotest System Error Codes, *continued*

Non-Surgical AutoGuide Error Codes, *continued*

Error Number	Error Code	Definition	Cause/Corrective Action
ERR63	NEEDLE_HOME_ERR	Needle not at home during move	Check the needle home sensor circuit. Trace the HOME_D signal, including the bypass jumper. Note that current positioners do not use the home sensor and therefore the signal must be bypassed on the motor control board.
ERR64	WDOG_RST_ERR	Watchdog reset error	The watchdog timer has forced a reset because the 8032 software has stopped running or the manual reset button on the motor control board has been pressed. If this error occurs during normal operation, replace the motor control board.
ERR70	EEPROM_RD_ERR	EEPROM read error	These errors indicate problems reading or writing to the X24C16 EEPROM. If the error persists, replace the motor control board.
ERR71	EEPROM_WR_ERR	EEPROM write error	
ERR72	V8_RMTE_ERR	+8V remote supply error	Check the +8V remote supply, including fuses.
ERR73	V5_ENC_ERR	+5V encoder supply error	Check the +5V encoder supply and fuses on the motor control board. If the fuse is blown, check for shorts in the positioner or wiring.
ERR74	V24_ERR	+24V relay supply error	The +24V relay supply is faulty. Replace the motor control board.

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Mammovision/Mammotest System Error Codes, *continued*

Non-Surgical AutoGuide Error Codes, *continued*

Error Number	Error Code	Definition	Cause/Corrective Action
ERR75	V32_MTR_ERR	+32V motor supply error	Check the +32V power supply and fuses on the motor control board. If the fuse is blown, check for shorts in the positioner or wiring.
ERR76	MC_INIT_ERR	LM629MC motion controller initialization error	Replace the motor control board. The LM629 cannot communicate with the 8032 microprocessor.
ERR77	HOME_RANGE_ERR	Home calibration offset out of range	The home offset calibration procedure was attempted with too large an offset. Repeat the calibration procedure with a smaller offset.
ERR78	STUCK_ENABLE_ERR	Stuck motion enable error	The motion enable switch is stuck in the ON positioner has been manually pressed for more than 30 seconds. Check the motion enable circuits and replace the motor control board if needed.

Mammovision/Mammotest System Error Codes, *continued*

Surgical AutoGuide Error Codes

Error Message	Cause/Corrective Action
No Target Data	Select a target with the Mammovision system. If the AutoGuide does not receive the target from the Mammovision, return the AutoGuide to the factory for repair.
Coarse Vertical Position Error	Attempt to reposition the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.
Coarse Horizontal Position Error	Attempt to reposition the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.
Fine Vertical Position Error	Attempt to reposition the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.
Fine Horizontal Position Error	Attempt to reposition the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.
Vertical Position Error	Attempt to reposition the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.
Horizontal Position Error	Attempt to reposition the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.
Unknown Error	Unplug the AutoGuide, then plug it back in. If this does not clear the error, return the AutoGuide to the factory for repair.
Position Error	Attempt to reposition the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.

Continued on next page

Mammovision/Mammotest System Error Codes, *continued*

Surgical AutoGuide Error Codes, *continued*

Error Message	Cause/Corrective Action
Enable Switch was Released Before Movement Completed Causing a Position Error	Press the enable switch until movement is complete. If this does not clear the error, return the AutoGuide to the factory for repair.
Table Movement is Enabled. Please Disable Table and Try Again.	Disable the table movement. If the table is disabled, and this does not clear the error, return the AutoGuide to the factory for repair.
Current Fault	Check that the AutoGuide is able to move freely. If the error remains even though the AutoGuide is able to move freely, return the AutoGuide to the factory for repair.
Initial Home Has Not Been Done. Home AutoGuide First.	Press the Enable switch and HOME on the AutoGuide until it stops movement. If this does not clear the error, return the AutoGuide to the factory for repair.
Enable Switch was not Pushed. No Movement can Occur.	Press the Enable switch, then initiate movement. If this does not clear the error, return the AutoGuide to the factory for repair.
Warning Negative Stroke Margin	The needle depth is set to less than 4mm from the carbon fiber plate.
Invalid Code	The security code was entered incorrectly. Re-enter the security code.
Waiting for Communication	The RS-422 communication link to the Mammovision has failed. Check the cables and the RS-422 card. Disconnect and reconnect the AutoGuide. If this does not clear the error, return the AutoGuide to the factory for repair.

Mammovision/Mammotest System Error Codes, *continued*

Mammovision Error Codes Displayed on the Generator

Error Number	Error Code	Description	Cause/Corrective Action
E35	CCD Stuck True		• Cycle system power to reboot • Re-attempt operation • Reseat all of the Mammovision circuit boards • Check for a communication problem with the generator cabinet • Check LEDs on CPU I/O board
E36	CCD Not Ready		• Cycle system power to reboot • Re-attempt operation • Reseat all of the Mammovision circuit boards • Check the camera power supply • Check the camera and computer circuit boards • Check communication with the generator • Check LEDs on CPU I/O board

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Mammovision/Mammotest System Error Codes, *continued*

Mammovision Error Codes Displayed on the Generator, *continued*

Error Number	Error Code	Description	Cause/Corrective Action
E37	CCD General - CCD Drops during an exposure	AEC/Manual exposure in progress	• Cycle system power to reboot • Re-attempt operation • Reseat all of the Mammovision circuit boards • Check communication with the generator • Check LEDs on CPU I/O board
E38	CCD AEC Stuck True		• Cycle system power to reboot • Re-attempt operation • Reseat all of the Mammovision circuit boards • Check communication with the generator • Check LEDs on CPU I/O board

Mammovision/Mammotest System Error Codes, *continued*

Mammovision Error Codes Displayed on the Monitor

Error	Cause/Corrective Action
Timeout waiting for first, second, third camera ready.	• Check that the camera is properly seated • Check that the power to the table is ON
Camera voltages are not correct	• Check that the camera is properly seated • Check that the camera power is ON • Check that the connector is seated securely
Error during acquisition!! Serial camera communications error	• Check that camera is properly seated • Check the cable for continuity or shorts
Partial image is displayed with no error message	• Check communication cable for discontinuity or short.
Image has blotches or is distorted with no error message.	• Check camera's serial interface board - replace if needed • Check for missing codes in the histogram

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Mammovision/Mammotest System Error Codes, *continued*

Mammovision Error Codes Displayed on the Monitor, *continued*

Error	Cause/Corrective Action
No camera status was received. Cannot tell if camera is operational.	• Check that the table power is ON • Check that camera is properly mounted • Check that camera is properly seated • Remove power from Mammovision workstation and camera (table). Restore power first to the camera (by restoring power to the table) then to the Mammovision workstation. If the message appears when selecting Mammotest on the main menu, but not when selecting HF-X: • Check camera that connector is securely plugged into table. • Verify that a jumper is installed between Pin 3 on J1 and Pin 3 on J2 If the message appears when selecting HF-X on the main menu, but not when selecting Mammotest: • Check camera to generator connector. • Verify that jumper is removed between Pin 3 on J1 and Pin 3 on J2

Functional Checks and Procedures

Athena HF Generator and System Checks

- Incoming Line Inspection
- Preliminary Test Inspection
- Switch Setting Inspection
- Check System Operation
- Check Mechanical Operation
- Check Bucky Operation
- Check Instantaneous Power Tube Overload
- Check Radiographic mAs Measurements
- Check Radiographic Time Measurements
- Check Radiographic kV/mA Measurements
- Check Linearity and Reproducibility
- Check Beam Quality Half Value Layer
- Check Transmission Limit for Image Receptor Support Devices
- Check Contrast of Light-Defined X-Ray Fields
- Check Illumination of Light Localization
- Alignment Checks and Procedures
- Check Leakage Radiation from the Diagnostic Source Assembly
- Check CompuTracII Automatic Exposure Control Function
- Check AEC Stability
- Check Auto kV Step Response
- Check Image Quality

Mammovision/Mammotest System Checks

- Check Mammotest Plus/S Table Function
- Mammovision/Mammotest System Checks, continued
- Mammovision Preliminary Setup
- Mammovision Daily Calibration Check
- Checking the Camera for Artifacts
- Check Camera Sensitivity and Serial Illumination
- Check Camera Automatic Exposure Control (AEC) Function
- Check Camera Noise and Dark Current
- Check Image Quality
- Check Reproducibility for AEC
- Stereo Exposure Procedure
- AutoGuide Functional Checks
- Archiving and Retrieving Functional Test Data

Athena HF Generator and System Checks

The following checks are performed to ensure that the Athena meets acceptance requirements. The test data must be recorded, and a completed copy of the Acceptance Data Sheets must be filed for future reference. **Click here for copies of the Acceptance Data Sheets**.

For an Athena HF System, perform all of the checks in this section.

For a Mammovision/Mammotest system that uses the Athena Generator, perform the following checks:

- Incoming Line Inspection
- Preliminary Test Inspection
- Check Jumper and Switch Setting
- Check Mechanical Operation
- Check Instantaneous Power Tube Overload
- Check Radiographic mA Measurements
- Check Radiographic Time Measurements
- Check Radiographic kV/mA Measurements
- Check Linearity and Reproducibility
- Check Beam Quality Half Value Layer

Before starting these functional checks, be sure to document the Athena system configuration and the test equipment used on the **Mammovision System Configuration Information** and **Mammovision Test Equipment Information** data sheets.

If, during any procedure, the system does not meet specifications, discontinue the procedure immediately, correct the problem, and restart the procedure.

Incoming Line Inspection

1. Record the system nominal incoming line voltage on the **Preliminary Inspection Data** sheet.
2. Measure and record the incoming line voltage with no load.
3. Measure and record the incoming line voltage with a load, following the steps below:
   a. Warm up the x-ray tube using either the **X-Ray Tube Warm-Up Procedure** or the **X-Ray Tube Seasoning Procedure**.
   b. Make two exposures using 39kV, 125mA and a mAs value that will cause the exposure to last approximately 1 second.
4. Calculate and record the percent line regulation.

Athena HF Generator and System Checks, *continued*

Preliminary Test Inspection

Conduct this inspection before beginning any test procedures. Record compliance on the **Preliminary Inspection Data** sheet. If, during any procedure, the machine does not meet specifications, discontinue the procedure immediately, correct the problem, and restart the procedure from the beginning.

1. Verify that the system is in compliance with the specifications of the sales order.
2. Record compliance
3. Visually inspect the system for proper general appearance.
4. Record compliance.
5. Verify that all test equipment is connected properly.
6. Record compliance.
7. Position a casette and set the collimation to full (if there are two collimators, set both collimator controls to open).
8. Check that the primary x-ray beam is free of obstruction.
9. Place a small washer or coin on the center of the cassette.
10. Press the x-ray switch to the first catch.
11. Record compliance.

Athena HF Generator and System Checks, *continued*

Switch Setting Inspection

Before powering up the system and performing operational checks, verify that the **SW3 switch** on the Athena CPU is correctly installed, based on the tables below:

Table 7: SW3 Positions for 2-Tube System.

Switch	Position	Function
1	closed	enables tube 1
2	closed	enables tube 2
3	open	spare
4	open	spare

Table 8: SW3 Positions for Single-Tube System.

Switch	Position	Function
1	closed	enables tube 1
2	open	disables tube 2
3	open	spare
4	open	spare

Check System Operation

This check determines that the system is completely operational, and should be done before beginning the functional checks.

1. Activate the motion locks.
2. Check that the imaging unit remains locked in place for both up and down motion.
3. Verify movement of the compression assembly.
   - For mechanical compression assemblies, verify free and smooth movement.
   - For motorized compression devices, test the pressure adjustment by feeling the force needed to stop movement at the extreme pressure settings. Ensure that there is a difference between the lowest and highest pressure settings.
4. Check that the rotational movement is smooth, and that various positions lock and unlock easily.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check System Operation, *continued*

5. Check that the generator self-diagnostic test is performed at start-up, and that the preselected technique values match the table below.

Table 9: Preselected Technique Selections

Name	Value
kV	25
mA	100
mAs	750
CompuTracII On/Off	ON
Density	ON
Reset	OFF
Grid	ON
Density	0

6. Check that the status display changes in response to value and selection changes from the control panel.
7. Check that the collimator lamp turns on as the switch is released, then automatically shuts off after 35 ± 10 seconds.

Check Mechanical Operation

This check verifies simple mechanical motion. Record comments on the **Preliminary Inspection Data** sheet. If, during any procedure, the machine does not meet specifications, discontinue the procedure immediately, correct the problem, and restart from the beginning.

Pre-X-Ray Checks

1. Check the paddle assembly for vertical motion upward. Pressing the foot switch to the left releases the paddle assembly, but does not move it.
2. Check the paddle for vertical motion downward.
3. Check the solenoid brake gap.
4. Check that the compression arm pivots freely, with catches at 0°, +90°, and -90°.
5. If the unit uses motorized compression, check that the compression force can be varied from 15 to 40 pounds of pressure.
6. Check that the variable aperture moves freely.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Mechanical Operation, *continued*

7. Check the casette insertion force.
8. Check the casette fit - it must be snug.
9. Check the casette lateral play.
10. Check the insertion force and fit for all applicable accessories such as:
    - Large and small Bucky assembly
    - Large casette platform adaptor
    - Large and small cassette
    - Cassette holder
    - Large and small grid tunnel
    - Cassette size adaptor

X-Ray Operation Checks

1. Position a cassette and set the collimation to full (or if two tubes are used, set both collimator controls to open).
2. Check that the primary x-ray beam is free of obstruction.
3. Place a small washer or coin on the center of the cassette.
4. Press the x-ray switch to the first catch.
5. Check that the rotor starts in boost, then switches to the run state. There are a couple of indications to notice when the rotor switches state:
    - The rotating anode sound changes pitch
    - A slight bump may be felt by placing your hand, palm down, on the x-ray tube.
6. Observe the control panel as the system completes a self-diagnostic program. When the program is finished, the "Ready" indicator will light, indicating that the system is ready to make an exposure.
7. With the x-ray switch pressed to the second catch, check that the "X-Ray" indicator on the control panel is lit, and stays lit during the exposure. Also check that an alert noise sounds during the exposure.
8. Develop the film and save it for use with final verification of system operation and alignment.

Athena HF Generator and System Checks, *continued*

Check Bucky Operation

To check that the Bucky is operating properly, verify that the Bucky grid moves across the exposure plane, then back to the starting point using the following steps.

1. Lock the Bucky in place.
2. At the Athena generator, select
   23.5 kV
   100 mA
   40 mAs
3. Move the Athena x-ray arm to the down position or 0°.
4. Press "Grid Enable" until the Grid Enable indicator light is lit.
5. Load a film cassette with OM-1 film and an Min-R screen.
6. Place the 4cm plexiglas phantom, the Bucky compression paddle and loaded film cassette in the path of the x-ray.
7. Make an exposure.
8. Develop one sheet of film.
9. Make a second exposure at 1 second, with the following technique selection
   23.5 kV
   25 mA
   25 mAs
10. Make a third exposure at 4 seconds, with the following technique selection:
    23.5 kV
    15 mA
    60 mAs
11. Repeat steps 1 to 10 with the x-ray arm at 45°.
12. Verify that each of the six films are free of grid lines. If grid lines appear on any of the exposures, return the Bucky for service.

Athena HF Generator and System Checks, *continued*

Check Instantaneous Power Tube Overload

1. Select maximum kV, mA and mAs from the table below for an allowable exposure at approximately 100% tube load. Check that the "Tube Overload" indicator does not light.
2. Select the kV, mA and mAs from the table below for an exposure above 100% tube load. Check that the "Tube Overload" indicator does light.

Table 10: Instantaneous Power Tube Overload Technique Selections

Select	Small Focus		Large Focus	
	Allowable Exposure	Tube Overload	Allowable Exposure	Tube Overload
kV	28	33	21	39
mA	15	25	100	125
mAs	75	10	750	120

Check Radiographic mAs Measurements

1. Use the last digit of the serial number to select the technique factors from the table below

Table 11: Technique Selections for mAs Verification:

	For exposures 1-5		For exposures 6-10	
Last Digit	mA	kV	mA	kV
1	125	25	100	28
2	15	26	125	24
3	25	29	100	25
4	15	24	125	28
5	100	25	125	27
6	25	30	100	26
7	15	30	125	26
8	15	25	100	25
9	25	28	125	28
0	125	25	100	30

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Athena HF Generator and System Checks, *continued*

Check Radiographic mAs Measurements, *continued*

2. Record the selected values for kV and mA on the **mAs Data** sheet.
3. Take 10 exposures - the first 5 with one set of kV and mA values, and the second 5 with a different set of values and record the actual mAs value for each exposure.
4. Verify that the actual mAs fall within the limits listed on the data sheet.

Check Radiographic Time Measurements

Exposure time tests are not a required element of functional testing; however, exposure time can be determined using the mA waveform.

Exposure time is defined as the pulse width of the mA wave form starting when it reaches 75% or its maximum value, and ending at the grid bias cutoff.

Check Radiographic kV/mA Measurements

Use data sheet **Radiographic kV/mA Data** to record the results of the following tests.

1. Make an exposure using 25kV, 125mA and 10mAs. Record the actual kV and mA values.
2. Make an exposure using 28kV, 125mA and 10mAs. Record the actual kV and mA values.
3. Make an exposure using 33kV, 125mA and 10mAs. Record the actual kV and mA values.
4. Make an exposure using 39kV, 125mA and 10mAs. Record the actual kV and mA values.
5. Make an exposure using 25kV, 100mA and 60mAs. Record the actual kV and mA values.
6. Make an exposure using 28kV, 100mA and 60mAs. Record the actual kV and mA values.
7. Make an exposure using 33kV, 100mA and 60mAs. Record the actual kV and mA values.
8. Make an exposure using 39kV, 100mA and 60mAs. Record the actual kV and mA values.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Radiographic kV/mA Measurements, *continued*

9. Make an exposure using 25kV, 25mA and 6mAs. Record the actual kV and mA values.
10. Make an exposure using 28kV, 25mA and 6mAs. Record the actual kV and mA values.
11. Make an exposure using 33kV, 25mA and 6mAs. Record the actual kV and mA values.
12. Make an exposure using 39kV, 25mA and 6mAs. Record the actual kV and mA values.
13. Make an exposure using 25kV, 15mA and 10mAs. Record the actual kV and mA values.
14. Make an exposure using 28kV, 15mA and 10mAs. Record the actual kV and mA values.
15. Make an exposure using 33kV, 15mA and 10mAs. Record the actual kV and mA values.
16. Make an exposure using 39kV, 15mA and 10mAs. Record the actual kV and mA values.
17. Repeat steps 1 through 4 using the kV, mA and mAs values in Part 3 of the **Radiographic kV/mA Data** data sheet.
18. Repeat steps 1 through 16 using the kV, mA and mAs values in Part 2 of the **Radiographic kV/mA Data** data sheet.
19. Verify that all mA and kV values recorded are within the stated limits listed in the tables.

Athena HF Generator and System Checks, *continued*

Check Linearity and Reproducibility

Use data sheet **Linearity and Reproducibility Data** to record the results of the following tests.

1. Measure and record the line voltage at no load.
2. Select and record the technique factors you will use from the table below. Use the last digit of the serial number to determine which values to choose.
   Set 1 = mA1 + corresponding kV and mAs.
   Set 2 = mA2 + corresponding kV and mAs
   Set 3 = mA3 + corresponding kV and mAs
   Set 4 = mA4 + corresponding kV and mAs

Table 12: Linearity and Reproducibility Technique Selections

Last Digit	Select values:				Select values:			
	mA1	mA2	kV	mAs	mA3	mA4	kV	mAs
1	25	15	30	20	100	125	28	40
2	100	125	24	100	25	30	27	45
3	125	100	25	80	100	125	28	200
4	25	30	26	30	125	100	26	50
5	125	100	25	30	25	15	30	30
6	125	100	27	120	100	125	28	100
7	25	15	28	30	125	100	26	40
8	100	125	24	40	25	30	26	30
9	125	100	27	10	100	125	27	90
0	100	125	26	60	125	100	25	120

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Linearity and Reproducibility, *continued*

3. Make an exposure using Set 1 values, and record the load voltage (Load) and the measured radiation (mR) in the Actual Set 1 column on the **Linearity and Reproducibility Data** data sheet.
4. Calculate the Actual Set 1 line regulation and record this value on the data sheet in the% column. Line regulation is calculated as follows:

$$\%Regulation = \frac{100 \times (V_{NoLoad} - V_{Load})}{V_{Load}}$$

5. Change the value for each technique factor, then set the values to the Set 2 technique factors.
6. Make an exposure using Set 2 values, and record the load voltage (Load) and the measured radiation (mR) in the Actual Set 2 column on the **Linearity and Reproducibility Data** data sheet.
7. Calculate the Actual Set 2 line regulation and record this value on the data sheet in the % column.
8. Change the value for each technique factor, then reset the values to the Set 3 technique factors.
9. Make an exposure using Set 3 values, and record the load voltage (Load) and the measured radiation (mR) in the Actual Set 3 column on the **Linearity and Reproducibility Data** data sheet.
10. Calculate the Actual Set 3 line regulation and record this value on the data sheet in the% column.
11. Change the value for each technique factor, then reset the values to the Set 4 technique factors.
12. Make an exposure using Set 4 values, and record the load voltage (Load) and the measured radiation (mR) in the Actual Set 4 column on the **Linearity and Reproducibility Data** data sheet.
13. Calculate the Actual Set 4 PercentRegulation and record this value on the data sheet in the % column.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Linearity and Reproducibility, *continued*

14. Calculate and record the average percent load (%) and average radiation (mR) as follows:

$$AveragRadiation = \frac{Actual1(mR) + Actual2(mR) + Actual3(mR) + Actual4(mR)}{4}$$

$$Ave\%Load = \frac{Actual1(\%) + Actual2(\%) + Actual3(\%) + Actual4(\%)}{4}$$

15. Calculate the average mR/mAs as shown below, and record the value for each exposure.

$$\text{average mR per mAs} = \frac{\text{calculated average mR value}}{\text{indicated mAs value}}$$

16. Calculate the linearity of exposures 1 and 2 and the linearity of exposures 3 and 4 using the equations below. Record these values on the data sheet.

$$\text{Linearity of Exposures 1 and 2} = \frac{\frac{Ave(mR1)}{mAs} - \frac{Ave(mR2)}{mAs}}{\frac{Ave(mR1)}{mAs} + \frac{Ave(mR2)}{mAs}}$$

$$\text{Linearity of Exposures 3 and 4} = \frac{\frac{Ave(mR3)}{mAs} - \frac{Ave(mR4)}{mAs}}{\frac{Ave(mR3)}{mAs} + \frac{Ave(mR4)}{mAs}}$$

17. Calculate the standard deviation using the formula below. This value will be used in calculating the coefficient of variation.

$$\text{Std. Dev.} = \frac{\sqrt{(mR - mR_1)^2 + (mR - mR_2)^2 + (mR - mR_3)^2 + (mR - mR_2)^2}}{n - 1}$$

where:

mR = Average radiation (mR)

mR_1 = Average radiation (mR) of exposure 1

mR_2 = average radiation (mR) of exposure 2

mR_3 = average radiation (mR) of exposure 3

mR_4 = average radiation (mR) of exposure 4

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Linearity and Reproducibility, *continued*

18. Calculate and record the coefficient of variation using the formula below:

$$\text{Coefficient of Variation} = \frac{s}{\bar{x}} = \left[\sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n-1}\right]^{\frac{1}{2}}$$

where:

$\bar{x}$ = mean value of observation in sample
x_i = i-th observation sampled
s = estimated standard deviation of the population
n = number of observations sampled

19. Verify that the coefficient of variation is less than or equal to 0.035.

Check Beam Quality Half Value Layer

The half value layer for this system must conform to 0.3 mm of aluminum at an operating kV of 30.

1. Check that all normal beam filtration is in place.
2. Set the collimator to the smallest field size.
3. Set the technique factors to
   30kV
   100mA, and
   100mAs
4. Place a stabilized dose meter probe centered in the x-ray beam, and at a distance of about 66 cm (at the image receptor platform).
5. Measure and record the unfiltered x-ray dose of 4 exposures. Data sheet **Beam Quality Half Value Layer Data** is provided to record this data.
6. Tape a 0.2mm aluminum-equivalent filter (1100 alloy) to the output of the collimator.
7. Make 4 exposures, measuring and recording the filtered x-ray dose of each.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Beam Quality Half Value Layer, *continued*

8. Remove the 0.2 mm filter and attach a 0.3 mm aluminum-equivalent filter (1100 alloy) to the output of the collimator.
9. Make 4 exposures, measuring and recording the filtered x-ray dose of each.
10. Remove the 0.3 mm filter and attach a 0.4 mm aluminum-equivalent filter (1100 alloy) to the output of the collimator.
11. Make 4 exposures, measuring and recording the filtered x-ray dose of each.
12. Calculate the totals for the four exposure sets and record in the "Totals" row of the data sheet.
13. Calculate and record the average dose for each exposure set.
14. Calculate and record the average unfiltered dose divided by 2.
15. Plot the average dose values (mR) from the three filtered exposure sets on the graph provided in the data sheet. See example below.
16. Connect the 3 points on the graph.
17. Place an X where the average unfiltered dose/2 intersects the curve drawn in the previous step.
18. Draw a vertical line from the X to the x-axis on the graph.
19. Check that the point indicated on the x-axis of the graph corresponds approximately to 0.3 mm Al.

Athena HF Generator and System Checks, *continued*

Check Beam Quality Half Value Layer, *continued*

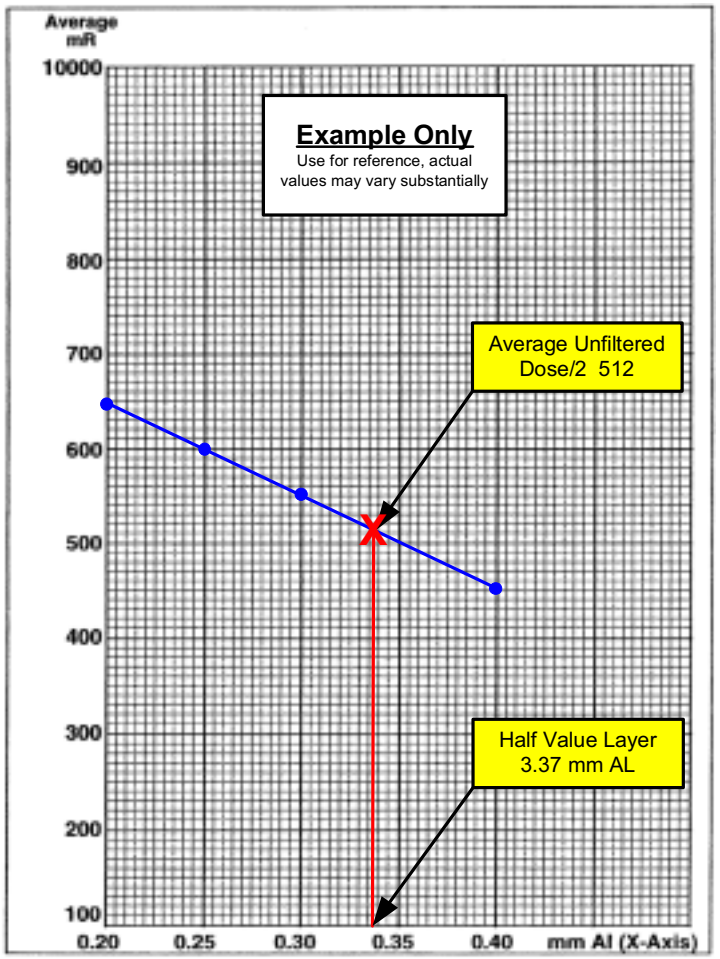


Figure 3: Sample Beam Quality Half Value Layer Graph

Athena HF Generator and System Checks, *continued*

Check Transmission Limit for Image Receptor Support Devices

1. Set the technique factors to
   39kV
   largest allowable mA station, and
   750mAs
2. Place the dosimeter 5 cm behind the image receptor support base, centered between the left and right sides.
3. Make an exposure and measure and record the radiation at the dosimeter.
4. Move the dosimeter to the left side of the image receptor, maintaining the 5cm separation.
5. Make a second exposure and measure and record the dosimeter radiation.
6. Move the dosimeter to the right side of the image receptor, again maintaining the 5 cm separation.
7. Make a third exposure and measure and record the dosimeter radiation.
8. Check that the radiation levels measured did not exceed 0.095 mR for any of the dosimeter positions.

Check Contrast of Light-Defined X-Ray Fields

1. Set the system up with the collimator wide open or at full field.
2. Place an oversized black film on the image receptor.
3. Turn the collimator lamp ON.
4. Measure the light level 3 mm from the center of the light field using a light meter with a 1 mm cap. Record this measurement (I_{FC}) on the **Light-defined X-Ray Field Contrast Data** data sheet.
5. Take a second measurement 3 mm from the edge of the light field with the adapted light meter. Record this value (I_{TC}).
6. Calculate the ratio of the two values as shown below.
7. Verify that the ratio meets the following minimums:

Table 13: Contrast Ratio Minimums

Contrast Ratio	Installation Type
minimum 4.2 : 1	beam-limiting devices that are corrected for ambient lighting and designed for stationary equipment
minimum 3 : 1	mobile equipment

Athena HF Generator and System Checks, *continued*

Check Illumination of Light Localization

The average illumination is based on measuring the approximate center of each quadrant of the light field.

1. Check to see that the light path is unobstructed.
2. Dim the room lights.
3. Separate the light beam into four imaginary quadrants as illustrated below.
4. Place the light meter on the top of the cassette, and in the approximate center of the first quadrant.
5. Set the light meter scale to measure 15 footcandles with the highest sensitivity.
6. Measure and record the ambient room illumination on the **Illumination of Light Localization Data** data sheet.
7. Turn on the collimator lamp.
8. Measure and record the total illumination of the first quadrant.
9. Measure and record the room illumination and the collimator lamp illumination in each of the remaining 3 quadrants.
10. Subtract the room illumination from the collimator lamp illumination for each quadrant and record this data in the "Light Difference" column on the **Illumination of Light Localization Data** data sheet.
11. Average the total illumination from each of the quadrants and record this value.
12. Check that the average illumination is greater than or equal to 16.7 LUX or 15.5 footcandles.

Alignment Checks and Procedures

Checking the Alignment of the Light Field to the X-Ray Field

The edges of the x-ray field must line up with the edges if the visually defined light field with a tolerance of not more than 1.95% of the distance from the source to the center of the light field.

1. Place an oversized 14" x 17" paper film holder, with one sheet of unexposed film, on the image receptor.
2. Turn the collimator lamp "ON."
3. Tape 5 markers, such as pennies, to the edges of the light field, as shown below.

Continued on next page

Athena HF Generator and System Checks, *continued*

Alignment Checks and Procedures, *continued*

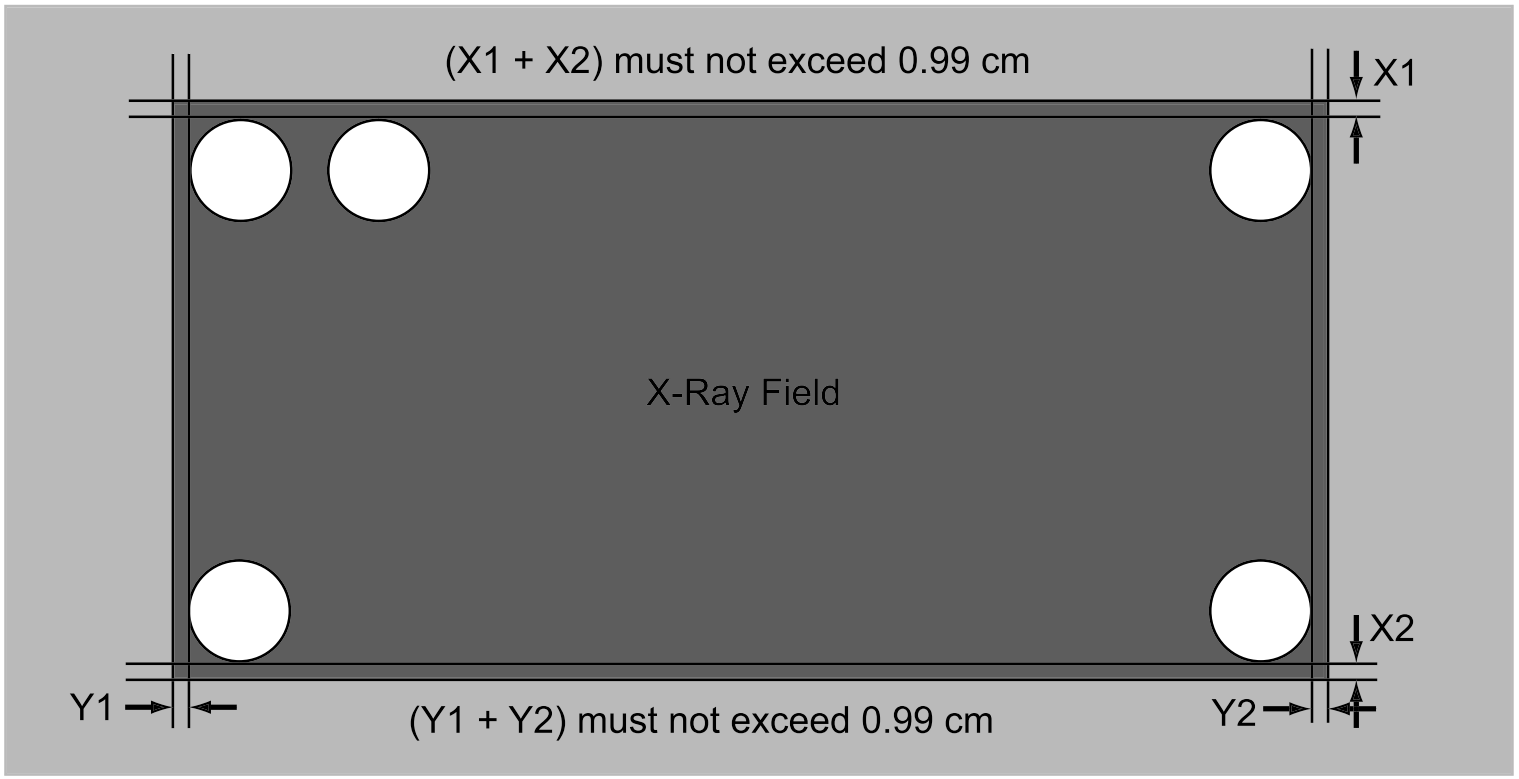


Figure 4: Penny Placement for Checking the Alignment of the Light Field to the X-Ray Field

Continued on next page

Athena HF Generator and System Checks, *continued*

Alignment Checks and Procedures, *continued*

4. Select technique factors of:
   26kV
   100mA
   80 mAs
5. Make one exposure and develop the film at a 1.15 - 1.50 optical density.
6. Check that the edges of the light field (indicated by the coin edges) aligns with the edge of the x-ray field.
   - On an Athena system, with a fixed source to image distance (SID) of 66 cm, the light and x-ray field must be aligned within 1.50% of 66 (0.99 cm).
   - On a Mammotest system with an SID of 68cm, the fields must be aligned within 1.50 of 68 cm (1.02 cm).
7. If necessary, adjust the collimator lamp as follows:
   - Adjust the collimator lamp to the left to compensate for a right-shifted light field.
   - Adjust the collimator lamp to the right to compensate for a left-shifted light field.
   - To compensate for a light field that is too far forward or backward, adjust the mirror.
8. Repeat steps 1 to 7 until the alignment is within the acceptable tolerance.

Beam Alignment Check

This procedure checks the alignment of the x-ray field to the image receptor.

1. Open the variable aperture to 24 x 30 cm.
2. Install a cassette clamp and cassette holder.
3. Secure an oversize 14" x 17" paper film holder containing one sheet of unexposed film under the image receptor. Ensure that the film is held against the underside of the receptor.
4. Turn the collimator lamp "ON."
5. Adjust the x-ray tube to center the light field from side to side. No vertical lines should project onto the film holder.

Continued on next page

Athena HF Generator and System Checks, *continued*

Alignment Checks and Procedures, *continued*

6. Select technique factors of:
   26kV
   100mA
   80 mAs.
7. Make one exposure and develop the film at a 1.15 - 1.50 optical density.
8. Check that the exposure edge on the film is a line at the image receptor approximately 1 cm wide, with the same thickness across and vertically.
9. Check that the total distance between the x-ray field and the image receptor edges is less than 1.50% of the SID distance (if SID distance is 66 cm, the edges should be aligned within less than 0.99 cm).
10. Repeat **step 5** to **step 9** until the alignment is within the acceptable tolerance.

Check Leakage Radiation from the Diagnostic Source Assembly

The Diagnostic Source leakage radiation is measured 1 meter in any direction from the source. Leakage radiation must be less than 95 mR in one hour.

1. Select technique factors of:
   39 kV
   15 mA
   45 mAs.
2. Completely block the x-ray beam with a lead sheet.
3. Make one set of 5 exposures at 100 cm away from the diagnostic source and at a height equal the height of the collimator and tube port junction (see figure x below). The five exposure locations should make a half circle around the diagnostic source.
4. Record the mR output at each of these locations on the **Leakage Radiation from Diagnostic Source Data** data sheet.
5. Make a second set of 5 exposures, still at 100 cm away from the source, but at a height that is 33 cm lower than the collimator bottom.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Leakage Radiation from the Diagnostic Source Assembly, *continued*

6. Record the mR output at each of these locations on the **Leakage Radiation from Diagnostic Source Data** data sheet.
7. Check that the leakage radiation at all points is less than 95 mR/hour.

Check CompuTracII Automatic Exposure Control Function

Important! Calibrate the kV and mA before performing the CompuTracII Automatic Exposure Control functional checks. An error of 0.5 kV can skew the optical density by as much as 30%.

Checking the CompuTracII Gain Adjustment

The gain adjustment is used to compensate for differences in film processor performance.

Important! The film processor must be clean, and the chemicals must be fresh and at the proper temperature for this test to be accurate.

1. Check that the CompuTracII is enabled.
2. Select technique factors of:
   28 kV
   100 mA
   750 mAs.
3. Load the film cassette with OM-1 film and a Kodak Min-R screen.
4. Place the following items in the x-ray beam's path:
   - 4 cm thick sheet of Plexiglas
   - Moving grid
   - compression paddle, and
   - the loaded film cassette.
5. Make one exposure and note the exposure time.
6. Adjust R9 on the preamp PCB until the exposure mAs equals 53 mAs ±3%.
7. Record the mAs value on the "Gain Adjustment and Reproducibility Data for the CompuTracII" data sheet.
8. Reload the film cassette and make another exposure with the CompuTracII.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check CompuTracII Automatic Exposure Control Function, *continued*

9. Develop this film, and check the optical density. If the optical density is not 1.25 ± 0.2, repeat steps 6 through 9 until the proper optical density is obtained.

Checking Reproducibility with the CompuTracII

1. Check that the CompuTracII is enabled.
2. Select technique factors of:
   - 28 kV
   - 100 mA
   - 750 mAs
   - density 0
3. Place a 4 cm thick sheet of Plexiglas between the x-ray source and the AEC detector.
4. Make five consecutive exposures, allowing one minute between exposures. Change all the technique factor values between exposures, then reset them to the original technique factors before the next exposure.
5. Calculate and record the Coefficient of Variation as follows:
   a. Calculate and record the Average Radiation (mR_A) as follows:

$$mR_A = \frac{mR_1 + mR_2 + mR_3 + mR_4}{4}$$

where
mR_1 = first reading
mR_2 = second reading
mR_3 = third reading
mR_4 = fourth reading

   b. Calculate and record the Standard Deviation (mR_{SD}) as follows:

$$mR_{SD} = \frac{\sqrt{(mR_A - mR_1)^2 + (mR_A - mR_2)^2 + (mR_A - mR_3)^2 + (mR_A - mR_2)^2}}{n-1}$$

where
mR_A = average mR
mR_1 = first reading
mR_2 = second reading
mR_3 = third reading
mR_4 = fourth reading

Continued on next page

Athena HF Generator and System Checks, *continued*

Check CompuTracII Automatic Exposure Control Function, *continued*

c. Calculate and record the coefficient of variation as follows:

$$mR_{CV} = \frac{mR_{SD}}{mR_A}$$

where
mR_A = Average radiation
mR_{SD} = Standard deviation

6. Check that the coefficient of variation is equal to or less than 0.035.

Check Density Compensation

1. Check that the CompuTracII is enabled.
2. Select the first set of technique factors based on the **Technique Selections for Density Compensation Verification** table below. Select the appropriate set based on the last digit of the unit's serial number.
3. Load the film cassette.
4. Place the following items in the x-ray beam's path:
   - Plexiglas of thickness from table below
   - Moving grid
   - compression paddle, and
   - the loaded film cassette.
5. Make the first exposure.
6. Change the technique factors and plexiglas thickness to match the second set of technique factors.
7. Make a second exposure.
8. Change the technique factors and plexiglas thickness to match the third set of technique factors.
9. Make a third exposure.
10. Change the technique factors and plexiglas thickness to match the 4th set of technique factors.
11. Make a fourth exposure.
12. Develop the film.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check CompuTracII Automatic Exposure Control Function, *continued*

13. Record the optical density of each of the exposures.
14. Record the actual displayed mAs for each exposure.

Table 14: Technique Selections for Density Compensation Verification

Last Digit	Set 1			Set 2			Set 3			Set 4		
	Plexiglas Thickness	mA	kV	Plexiglas Thickness	mA	kV	Plexiglas Thickness	mA	kV	Plexiglas Thickness	mA	kV
1	4	15	32	3	25	28	2	100	31	4	125	27
2	3	15	26	2	25	30	4	100	28	3	125	29
3	4	15	30	3	25	30	3	125	33	3	100	25
4	3	25	29	2	30	25	4	100	29	4	125	28
5	3	15	27	4	25	29	4	125	27	2	100	31
6	3	15	31	2	30	24	2	100	27	4	125	25
7	4	15	30	4	25	28	2	100	30	3	125	26
8	2	15	25	3	25	30	3	30	25	4	100	28
9	2	25	29	2	30	25	3	100	33	4	125	29
0	2	15	28	4	25	28	4	125	28	3	100	27

Athena HF Generator and System Checks, *continued*

Check CompuTracII Automatic Exposure Control Function, *continued*

Density Control Verification

1. Check that the CompuTracII is enabled.
2. Load the film cassette with MRM-1 film and a Kodak Min-R screen.
3. Place the following items in the x-ray beam's path:
   - a 4 cm thick sheet of Plexiglas
   - the moving grid
   - the compression paddle, and
   - the loaded film cassette.
4. Make an exposure and record the actual mAs at each of the density settings shown on the **Density Control Verification** data sheet.
5. Check that the actual mAs is within ±10% or the target mAs value shown on the data sheet.

Backup Termination Verification

Record the answers to these checks on the **Back-Up Termination Verification Data** data sheet.

1. Check that the CompuTracII is enabled.
2. Select technique factors of:
   28 kV
   100 mA
   40 mAs.
3. Make an exposure.
4. Check that the alert sounds and the reset lamp blinks.
5. Check that all buttons except "Reset" are inoperative. Be sure to check the "Prep/X-Ray" button.
6. Check that pressing the "Reset" button refreshes the display and allows further exposures.

Check AEC Stability

1. Connect the oscilloscope probe to U2, pin 6 on the AEC preamp board.
2. Set the oscilloscope for continuous sweep mode with 2V per division.
3. Check that the output displayed is 0V.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check AEC Stability, *continued*

4. Move the AEC detector through all positions and check that the output displayed on the oscilloscope remains stable at 0V.

Note If the oscilloscope display does not remain stable at 0V, check for and repair any grounding problems before continuing.

5. Select the following technique factors:
   27 kV
   100 mA
   AEC density = 04cm Plexiglas
   AEC detector in position 2
6. Make an AEC exposure.
7. Verify that the waveform shown on the oscilloscope is similar to the illustration below. The settling time should not exceed 15 seconds. A longer settling time indicates that the AEC is not working properly.

Note The slope of the waveform will vary, depending on mA, kV and Plexiglas thickness.

Check Auto kV Step Response

1. Select AEC ON.
2. Select Bucky ON.
3. Select 100mA.
4. Select "Normal" density.
5. Install a loaded film casette.
6. Place a 6cm thick Plexiglas and the compression paddle in the field of view.
7. Verify that the AEC kV light is not lit and that kV is set to 25.
8. Make an exposure.
9. Process the film and determine optical density.
10. Verify that the optical density is 1.25 ±0.3.
11. Record the mAs and final kV on the **Auto kV Step Verification Data** data sheet.

Athena HF Generator and System Checks, *continued*

Check Image Quality

Film information can be recorded on the RMI Model 156 Mammographic Accredation Phantom data sheets. Scoring information is on the **RMI Model 156 Mammographic Accreditation Phantom Scoring** data sheet.

1. Position the compression arm for cranio caudal (CC) view.
2. Install the bucky and film cassette.
3. Place the AEC detector in position 4.
4. Place an RMI Model 156 Mammographic Accredation Phantom on top of the Bucky and positioned over the AEC detector.
5. Lower the compression paddle until it just touches the top of the phantom.
6. Turn the AEC and the grid "ON"
7. Make the Film 1 exposure with the following techniques:
   24 kV
   100 mA
   select the large focal spot
8. Verify that the optical density is between 0.90 and 1.20.
9. Make the Film 2 exposure with the following techniques:
   25 kV
   100 mA
   select the large focal spot
10. Verify that the optical density is between 0.90 and 1.20.
11. Make the Film 3 exposure with the following techniques:
    26 kV
    100 mA
    select the large focal spot
12. Verify that the optical density is between 0.90 and 1.20.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Image Quality, *continued*

13. Score film 1 and record the results on the **RMI Model 156 Mammographic Accreditation Phantom Data for Film 1 (24 kV)** data sheet.
    a. Record the optical density.
    b. Circle the objects that are visible on film 1. Viewing should take place on a lit view box with all other room lighting off.
    c. Check that, at minimum, the following images are found:
    - four fibers (A, B, C, D);
    - three speck sets (G, H, I); and
    -three masses (L, M, N).
    d. Calculate and record the total score for film 1.
14. Score film 2 and record the results on the **RMI Model 156 Mammographic Accreditation Phantom for Film 2 (25 kV)** data sheet.
    a. Record the optical density.
    b. Circle the objects that are visible on film 2. Viewing should take place on a lit view box with all other room lighting off.
    c. Check that, at minimum, the following images are found:
    - four fibers (A, B, C, D);
    - three speck sets (G, H, I); and
    -three masses (L, M, N).
    d. Calculate and record the total score for film 2.
15. Score film 3 and record the results on the **RMI Model 156 Mammographic Accreditation Phantom for Film 3 (26 kV)** data sheet.
    a. Record the optical density.
    b. Circle the objects that are visible on film 3. Viewing should take place on a lit view box with all other room lighting off.
    c. Check that, at minimum, the following images are found:
    - four fibers (A, B, C, D);
    - three speck sets (G, H, I); and
    -three masses (L, M, N).
    d. Calculate and record the total score for film 3.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Image Quality, *continued*

16. Remove the Bucky.
17. Turn the grid off.
18. Place an RMI Model 156 Mammographic Accredation Phantom positioned over the AEC detector.
19. Lower the compression paddle until it just touches the top of the phantom.
20. Turn the AEC "ON"
21. Make the Film 4 exposure with the following techniques:
    23 kV
    100 mA
    select the large focal spot
22. Verify that the optical density is between 0.90 and 1.20.
23. Make the Film 5 exposure with the following techniques:
    25 kV
    100 mA
    select the large focal spot
24. Verify that the optical density is between 0.90 and 1.20.
25. Score film 4 and record the results on the **RMI Model 156 Mammographic Accreditation Phantom for Film 4 (23 kV)** data sheet.
    a. Record the optical density.
    b. Circle the objects that are visible on film 4. Viewing should take place on a lit view box with all other room lighting off.
    c. Check that, at minimum, the following images are found:
    - four fibers (A, B, C, D);
    - three speck sets (G, H, I); and
    -three masses (L, M, N).
    d. Calculate and record the total score for film 4.

Continued on next page

Athena HF Generator and System Checks, *continued*

Check Image Quality, *continued*

26. Score film 5 and record the results on the **RMI Model 156 Mammographic Accreditation Phantom for Film 5 (24 kV)** data sheet.

    a. Record the optical density.

    b. Circle the objects that are visible on film 5. Viewing should take place on a lit view box with all other room lighting off.

    c. Check that, at minimum, the following images are found:
    - four fibers (A, B, C, D);
    - three speck sets (G, H, I); and
    -three masses (L, M, N).

    d. Calculate and record the total score for film.

27. Verify that all films meet the criteria listed on the **RMI Model 156 Mammographic Accreditation Phantom Scoring** data sheet.

Mammovision/Mammotest System Checks

The following checks are performed to ensure that the Mammovision/Mammotest system meets acceptance requirements. The test data must be recorded, and a completed copy of the Acceptance Data Sheets must be filed for future reference. **Click here for copies of the Acceptance Data Sheets**.

For a Mammovision/Mammotest system that uses the Athena Generator, the following checks must be performed before the system checks in this section:

- **Incoming Line Inspection**
- **Preliminary Test Inspection**
- **Check System Operation**
- **Check Mechanical Operation**
- **Check Instantaneous Power Tube Overload**
- **Check Radiographic mAs Measurements**
- **Check Radiographic Time Measurements**
- **Check Radiographic kV/mA Measurements**
- **Check Linearity and Reproducibility**
- **Check Beam Quality Half Value Layer**

Before starting these functional checks, be sure to document the Mammovision system configurathion and the test equipment used on the **Mammovision System Configuration Information** and **Mammovision Test Equipment Information** data sheets.

If, during any procedure, the system does not meet specifications, discontinue the procedure immediately, correct the problem, and restart the procedure from the beginning.

Mammovision/Mammotest System Checks, *continued*

Check Mammotest Plus/S Table Function

Record table data on the **Mammotest Table Test Data** data sheet.

Check Table

1. Check the vertical motion of the table for full up and down travel. No binding or unusual noise should occur.
2. Check that the table can move through the entire horizontal range between +120° and -120°.
3. Check the vertical motion of the arm for full up and down travel. No binding or unusual noise should occur.
4. Release the longitudinal brake.
5. Check that the brake releases and the table moves smoothly between longitudinal stops.
6. Release the transverse and longitudinal brakes.
7. Check that the table panning motion is smooth.
8. Verify that the "Enable" switch prevents movement of the table and controls.

Check Compression Force

1. Install the compression scale on the arm.
2. Turn the **compression force adjustment** to 10.
3. Close the compression device and check that the maximum force is 40 lbs. (1.81 kg).
4. Open the compression device.
5. Turn the compression force adjustment to 1.
6. Close the compression device and check that the minimum force is 15 lbs. (1.81 kg).
7. Open the compression device.
8. Turn the compression force adjustment to 5.
9. Close the compression device and check that the compression force is maintained for 30 minutes.

Mammovision/Mammotest System Checks, *continued*

Check Mammovision Collimator Field Centering

1. At the Mammovision screen, select:
   Utilities
   Analysis
   Get Images
   Acquire Raw
   Exposure Control
   Manual
   Store A
2. Select
   23 kV,
   100 mA, and
   10 mAs at the generator cabinet.
3. Install the CCD collimator (5 cm x 5 cm).
4. Set the x-ray angle to 0.
5. Make an exposure.
6. Verify that the x-ray field covers the screen.
7. At the Mammovision screen, select:
   Done
   Done
   Done

Mammovision Preliminary Setup

1. At the Mammovision screen, select:
   Utilities
   Install
2. Type "FISCHER" at the password prompt.
3. Select:
   Distort Mapping
4. Enter the serial number of the camera.
5. Select:
   Done
6. Select:
   System Config
7. Enable the "Defect Fix Image" and the "Enhanced Correct" functions. When enabled, the icons will turn black.
8. Select
   Done
   Done
   Analysis

Mammovision/Mammotest System Checks, *continued*

Mammovision Daily Calibration Check

1. Check that the 5 cm x 5 cm aperture is installed.
2. Use the compression paddle to hold the scatter phantom in the x-ray field.
3. At the Mammovision screen, select:
   Get Images
   Acquire Raw
   Exposure Control
   Manual
   Store A
4. Select the manual techniques of:
   26 kV
   100 mA
   120 mAs
5. Make an exposure.
6. At the Mammovision screen, select:
   Done
   Image Analysis
   ROI
7. Draw an ROI of approximately 200 x 200 pixels in the center of the image.
8. At the Mammovision screen, select:
   Stats
9. Examine the mean (Avg) value in the lower right corner of the screen.
10. At the Mammovision screen, select:
    Cancel
11. Repeat steps 3 through 10, adjusting the kV and mAs until you achieve a mean value between 1000 and 2000.
12. At the Mammovision screen, select
    Done
    Done
    Daily Calibrate
13. The camera then acquires a 0.1 second dark image and a 9.9 second dark image while the screen displays "Loading".
14. Once the camera is finished acquiring the dark images, make 8 successive manual shots with the same technique.

Mammovision/Mammotest System Checks, *continued*

Checking the Camera for Artifacts

1. Position the x-ray tube at 15°.
2. At the Mammovision screen, select
   Utilities
   Analysis
   Get Images
   Acquire Corrected
   Store A
3. Select the following technique factors:
   23 kV
   100 mA
   10 mAs
4. Make an exposure.
5. Check the image for artifacts.
6. If artifacts are present, select the following
   Done
   Image Analysis
   ROI
7. Draw a line across both the white and black halves of the artifact. Extend the line on both sides of the spots, but keep the line as short as possible.
8. At the Mammovision screen, select:
   Plots
9. The plot will show a positive and negative deviation from the baseline. The number of pixels between the top of the positive and the bottom of the negative deviation indicate the depth of the artifact. If the artifact depth is greater than 4 pixels, the camera must be returned to the factory for service. See the table below for common artifact locations.

Table 15: Common Artifact Locations

Distance in Pixels	Location of Artifact
≤ 4	phosphor of the fiber optic reducer
> 4 but ≤ 11	foam material
> 11	carbon fiber window

Mammovision/Mammotest System Checks, *continued*

Check Camera Sensitivity and Serial Illumination

1. At the Mammovision screen, use the left trackball button to select:
   Utilities
   Analysis
   Get Images
   Acquire Corrected
   Store A
2. Select the following technique factors:
   23 kV
   100 mA
   10 mAs
3. Make an exposure. The system will acquire and store a corrected exposure and display a uniform image.
4. At the Mammovision screen, select:
   Done
   Image Analysis
   ROI
5. Draw a 200 x 200 pixel box in the center of the image.
6. At the Mammovision screen, select
   Statistic
   This displays the mean (average) value.
7. Check that the mean value is between 1500 and 3200.
8. Draw an ROI 1 row across the top of the image.
9. At the Mammovision screen, select
   Plots
   to display an x-y graph.
10. Check that the waveform is uniform (similar to the picture below).
11. Check that the mean value of the waveform is equivalent to the mean value in **step 6**.
12. At the Mammovision screen, select:
    Done
    Done
    Done
    Done
    to return to the initial screen.

Mammovision/Mammotest System Checks, *continued*

Check Camera Automatic Exposure Control (AEC) Function

1. At the Mammovision screen, use the left trackball button to select:
   Utilities
   Analysis
   Get Images
   Acquire Raw
   Exposure Control
   Manual
   Store A
2. Install the flat field phantom centered on the CCD camera.
3. Select the following technique factors:
   26 kV
   100 mA
   120 mAs
   manual exposure
4. Make an exposure.
5. Record the serial sum as Raw Sum 1 on the **Automatic Exposure Control Data** data sheet.
6. Repeat the exposure.
7. Record the serial sum as Raw Sum 2.
8. Average the values of Raw Sum 1 and Raw Sum 2.
9. Record this value.
10. At the Mammovision screen, use the left trackball button to select:
    Utilities
    Analysis
    Get Images
    Acquire Dark
    1.2
    Manual
    Store A
11. Make an exposure.
12. Record the serial sum as Dark Sum 1 on the **Automatic Exposure Control Data** data sheet.
13. Repeat the exposure.
14. Record the serial sum as Dark Sum 2.
15. Average the values of Dark Sum 1 and Dark Sum 2.
16. Record this value.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

Check Camera Automatic Exposure Control (AEC) Function, *continued*

17. Subtract the Dark Sum Average from the Raw Sum Average (Raw Sum Avg. - Dark Sum Avg.) and record this value as the difference value.
18. At the Mammovision screen, use the left trackball button to select:
    Done
    Done
    Install
19. Type "FISCHER" at the password prompt.
20. Select:
    Set AEC Level
    High Contrast
21. Enter the difference value calculated in step 17.
22. Select
    Done
23. Select
    Standard
24. Calculate the standard value, which is 75% of the difference value
    (Standard value = Difference value x 0.75).
25. Record this value as the standard value on the **Automatic Exposure Control Data** data sheet.
26. Enter the standard value calculated in step 24.
27. Select:
    Done
28. Select:
    Low Dose
29. Calculate the low dose value, which is 50% of the difference value.
    (Low Dose Value = Difference Value x 0.50)
30. Enter the low dose value.
31. Select:
    Done
    Done
    Done
    Analysis
    Get Images
    Acquire Corrected
    Exposure Control
    Standard
    Store A

Continued on next page

Mammovision/Mammotest System Checks, *continued*

Check Camera Automatic Exposure Control (AEC) Function, *continued*

32. Select the following technique factors:
    AEC ON
    26 kV
    100 mA
    300 mAs
33. Make an exposure.
34. Verify that the sum is within ±2% of the Standard Value calculated in step 24.
35. On the generator, select:
    Last Exp
36. Verify that the mAs shown is 120 ±10%.
37. Initial the **Automatic Exposure Control Data** data sheet.
38. At the Mammovision screen, select:
    Done
    Done

Check Camera Noise and Dark Current

1. At the Mammovision screen, use the left trackball button to select:
    Utilities
    Analysis
    Get Images
    Acquire Dark
    0.8
    Done
    Store A
    The system then automatically acquires and stores a 0.8 second dark exposure, then displays a uniform dark image.
2. Check the image for a uniform gray scale without artifacts or patterns.
3. At the Mammovision screen, select:
    Done
    Image Analysis
    ROI
4. Draw a box near the center of the image of approximately 200 x 200 pixels.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

Check Camera Noise and Dark Current, *continued*

5. At the Mammovision screen, select:
   Histogram
6. Check that the RMS value displayed is less than or equal to 15.
7. Verify that the histogram shape is a Gaussian curve without a large number of pixels above or below the curve, similar to the photo below.
8. Check that there is not more than one missing pixel.
9. At the Mammovision screen, select:
   Done
   Done
   Done
   Done

Check Image Quality

1. At the Mammovision screen, use the left trackball button to select:
   Utilities
   Analysis
   Get Images
   Acquire Corrected
   Exposure Control
   Standard
   Store A
2. Turn the Generator AEC ON.
3. Place an accredation phantom in the camera's field of view.
   a. If an RMI phantom is used, place the phantom so that the upper left corner of the phantom is visible in the camera's field of view.
   b. If a DME phantom is used, center the phantom in the camera's field of view.
4. Secure the phantom in place with the compression paddle.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

Check Image Quality, *continued*

5. Select the following technique factors:
   25 kV
   100 mA
   750 mAs
6. Make an AEC exposure.
7. If an RMI phantom is used,
   a. Move the phantom so that the upper right corner is visible in the camera's field of view.
   b. Take a second exposure.
   c. Select:
      Acquire Corrected
      Store B
   d. Move the phantom so that the lower left corner is visible in the camera's field of view.
   e. Take a third exposure.
   f. Select:
      Acquire Corrected
      Store C
   g. Move the phantom so that the lower right corner is visible in the camera's field of view.
   h. Take a fourth exposure.
   i. Select:
      Acquire Corrected
      Store D
8. Score the images and record the scores on the **RMI Model 156 Mammographic Accredation Phantom (1-25 kV) Data** data sheet using this scoring system:
   – Fiber scoring:
   If the full length of the fiber is visible with correct orientation and location, score 1 point
   If more than half of the fiber is visible with correct orientation and location, score 0.5 point.
   – Speck scoring:
   If four or five specks of the group are visible with correct location, score 1 point
   If two or three specks of the group are visible with correct location, score 0.5 point.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

Check Image Quality, *continued*

– Mass scoring:
If the density difference is visible in the correct location and the full circular edge of the mass is visible, score 1 point
If the density difference is visible in the correct location, but the full circular edge is not visible, score 0.5 point.

9. Check that they system meets or exceeds the minimum values given on the **RMI Model 156 Mammographic Accredation Phantom (1-25 kV) Data** data sheet.

10. Select:
Done
Done
Done

Check Reproducibility for AEC

1. Set up an AEC exposure that meets the following conditions
   – technique factors of 26 kV, 100 mA
   – Mammovision AEC selection of High Resolution, Standard or Low Dose
   – Sufficient material in the beam to yield an exposure of at least 100 mAs
   – backup mAs set to 200 mAs
2. Place the ion chamber of the x-ray monitor on the surface of the CCD image receptor.
3. Adjust the collimator so that the entire ion chamber is exposed to the x-ray radiation.
4. Make 10 successive exposures (within one hour) and record the radiation dose for each exposure on the **AEC Reproducibility Data** data sheet.
5. Calculate and record the Coefficient of Variation as shown on the data sheet.
6. Check that the Coefficient of Variation is within the acceptable level as shown on the data sheet.

Mammovision/Mammotest System Checks, *continued*

Stereo Exposure Procedure

1. Tape an x-spot BB, a BB phantom, a paper clip, or equivalent to the x-ray plate or to the compression paddle so that it is visible in either stereo image.

Note If the above equipment is not available, place the needle in the field of view at 0°H and 6.3°V, with the needle depth set to place the needle 1 cm from the carbon fiber plate.

2. At the Mammovision screen, select:
   Mammotest
3. Type "Test" in the last name field.
4. Select:
   Done
   Skip Scout Film
   Skip Digital Scout
   Exposure Control
   Manual
5. Release the x-ray tube arm and move the arm to the +15° position.
6. Secure the x-ray tube arm at this position, and check that the release lever is in the down position.
7. Select the following technique factors:
   23 kV
   100 mA
   10 mAs
8. Make an exposure.
9. Release the x-ray tube arm and move the arm to the -15° position.
10. Secure the x-ray tube arm at this position, and check that the release lever is in the down position.
11. Make another exposure.
12. Click on the center of the BB in the image on the left, then click the center of the BB in the image on the right.
13. At the Mammovision screen, select:
    Select Needle
14. Select the icon applying to the current needle. The icon will turn black when it is selected.
15. At the Mammovision screen, select
    Done

Continued on next page

Mammovision/Mammotest System Checks, *continued*

Stereo Exposure Procedure, *continued*

16. The AutoGuide will then receive the H, V, and D calculations.
17. Verify that the AutoGuide received the correct H, V and D values.
18. At the Mammovision screen, select:
    Save
    End Procedure
    Yes
    Patient Database
    Current Patient
    Delete Images
    Delete All
    Yes
    Delete Entry
    Yes
    Cancel

Mammovision/Mammotest System Checks, *continued*

AutoGuide Functional Checks

The generator, Mammotest Plus/S table, and Mammovision Plus system functional checks must be performed before the AutoGuide functional checks.

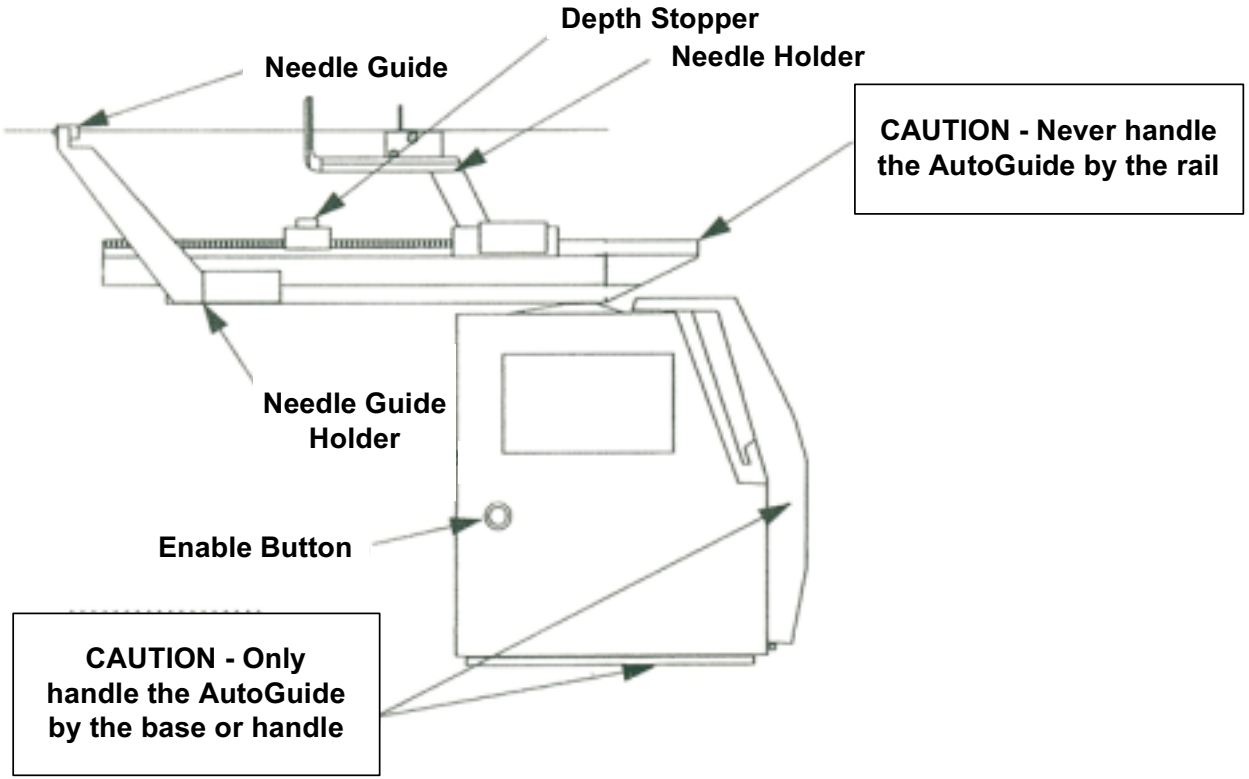

Depth Stopper
Needle Holder
Needle Guide
CAUTION - Never handle the AutoGuide by the rail
Needle Guide Holder
Enable Button
CAUTION - Only handle the AutoGuide by the base or handle

Figure 5: Autoguide and Needle Holder

Mammovision/Mammotest System Checks, *continued*

AutoGuide Functional Checks, *continued*

AutoGuide Motion Checks

Record the results of these motion checks on data sheet **Positioner Motion Test Data**.

1. Install the **AutoGuide** on the compression arm.

Caution	**The AutoGuide is very delicate.** Take extreme care when mounting the Autoguide on the compression arm. Always handle the Autoguide by the handle or by the base - never by the rail or motors.

2. Check the enable switch.
   a. Press TRG
   b. Press Manual
   c. Press an arrow button
   d. Press OFFS
   e. Verify that no movement occurs while the Enable switch is not pressed.
   f. Press and hold the Enable switch.
   g. Touch the Home button.
   h. Verify that the needle positioner moves toward the origin as long as the Enable switch is pressed. When the needle positioner stops, the display should read: H:0.00 V:0.00
3. Press the Enable button with the arrow buttons on the manual display to check the vertical motion of the positioner. Move the Autoguide through the full range of vertical motion, and check that no binding or unusual noise occurs.
4. Press the Enable button with the arrow buttons on the manual display to check the right to left motion of the positioner. Move the Autoguide through the full range of horizontal motion, and check that no binding or unusual noise occurs.
5. Press the Enable button with the arrow buttons on the manual display to position the Autoguide in the full up position.
6. Check that the positioner automatically stops.
7. Check that the position displayed on the Remote Control reads V:15.00 (±0.01°) with the surgical and V:12.00 (±0.01°) with the non-surgical AutoGuide.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

AutoGuide Functional Checks, *continued*

8. Press the Enable button with the arrow buttons on the manual display to position the Autoguide in the full down position.
9. Check that the positioner automatically stops.
10. Check that the position displayed on the Remote Control reads V:-5.00 (±0.01°) with the surgical and V:-4.00 (±0.01°) with the non-surgical Autoguide.
11. Press the Enable button with the arrow buttons on the manual display to position the Autoguide in the full left position.
12. Check that the positioner automatically stops.
13. Check that the position displayed on the Remote Control reads H:-12.00 (±0.01°) with the surgical and H:-10.00 (±0.01°) with the non-surgical AutoGuide.
14. Press the Enable button with the arrow buttons on the manual display to position the Autoguide in the full right position.
15. Check that the positioner automatically stops.
16. Check that the position displayed on the Remote Control reads H:12.00 (±0.01°)with the surgical and H:-10.00 (±0.01°) with the non-surgical AutoGuide.
17. Verify the system geometry with the system defaults.

Checking Frontal Approach Targeting Accuracy

1. Place the Target Verification Phantom on the carbon fiber plate with the three arrow tips pointing up and in to the imaging area (see below).
2. Secure the phantom with the compression paddle.
3. Install the AutoGuide on the compression arm with the frontal needle guide holder and the standard calibration needle for the frontal approach.
4. On the Mammovision screen, select:
   Utilities
   Target Verify
   Phantom
   Select Needle
5. Choose the needle description that matches the calibration needle being used.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

AutoGuide Functional Checks, *continued*

6. Select the following technique factors:
   23 kV
   100 mA
   10 mAs
   manual
7. Release the x-ray tube arm and move the arm to the +15° position.
8. Secure the x-ray tube arm at this position, and check that the release lever is in the down position.
9. Make an exposure.
10. Verify that all three arrows are visible on the monitor. If not, reposition the phantom and make another exposure until they are visible.
11. Release the x-ray tube arm and move the arm to the -15° position.
12. Secure the x-ray tube arm at this position, and check that the release lever is in the down position.
13. Make an exposure.
14. On the monitor, center the crosshair at the tip of an arrow on the first target image (left image), then click the left trackball button.
15. Move the crosshair to image 2 (right image) and center the crosshair at the tip of the arrow, then click the left trackball button.
16. On the monitor, center the crosshair at the tip of the second arrow on the first target image (left image), then click the left trackball button.
17. Move the crosshair to image 2 (right image) and center the crosshair at the tip of the same arrow, then click the left trackball button.
18. On the monitor, center the crosshair at the tip of the third arrow on the first target image (left image), then click the left trackball button.
19. Move the crosshair to image 2 (right image) and center the crosshair at the tip of the same arrow, then click the left trackball button.
20. Slide the needle back away from the phantom and move the AutoGuide to Target 1.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

AutoGuide Functional Checks, *continued*

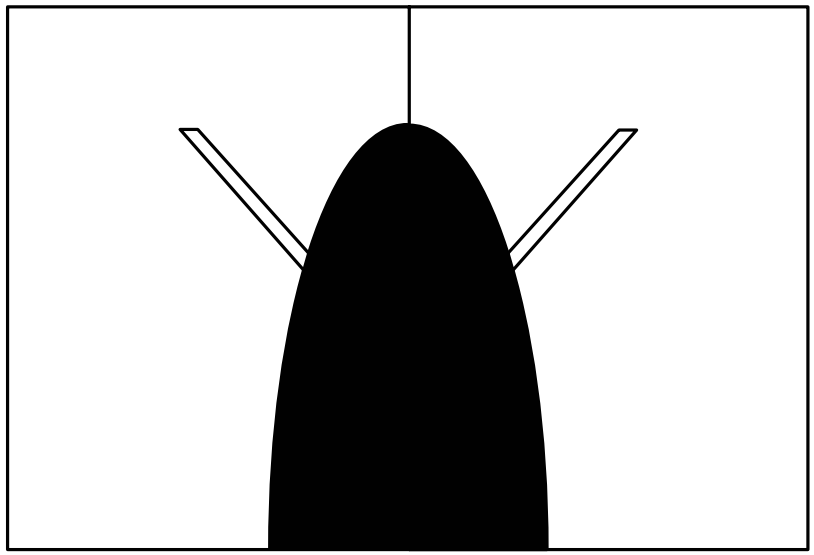
21. When the AutoGuide has finished moving, slide the needle forward until it reaches the arrow.
22. Verify that the center of the needle is in line with the tip of the arrow, and that the depth of the needle as read off of the AutoGuide rail matches the depth displayed on the monitor to within ±1 mm.
23. Record the results on the **Frontal Approach Position and Depth Accuracy Data** data sheet.
24. Slide the needle back away from the phantom and repeat **step 21** to **step 23** for Targets 2 and 3.
25. Check that the horizontal "Home" positioning is accurate.
    a. Place the needle at 6.5° vertical and 0.0° horizontal, with the needle tip placed close to the carbon fiber plate.
    b. Release the x-ray tube arm and move the arm to the +15° position.
    c. Secure the x-ray tube arm at this position, and check that the release lever is in the down position.
    d. Make an exposure.
    e. Release the x-ray tube arm and move the arm to the -15° position.
    f. Secure the x-ray tube arm at this position, and check that the release lever is in the down position.
    g. Make an exposure.

Mammovision/Mammotest System Checks, *continued*

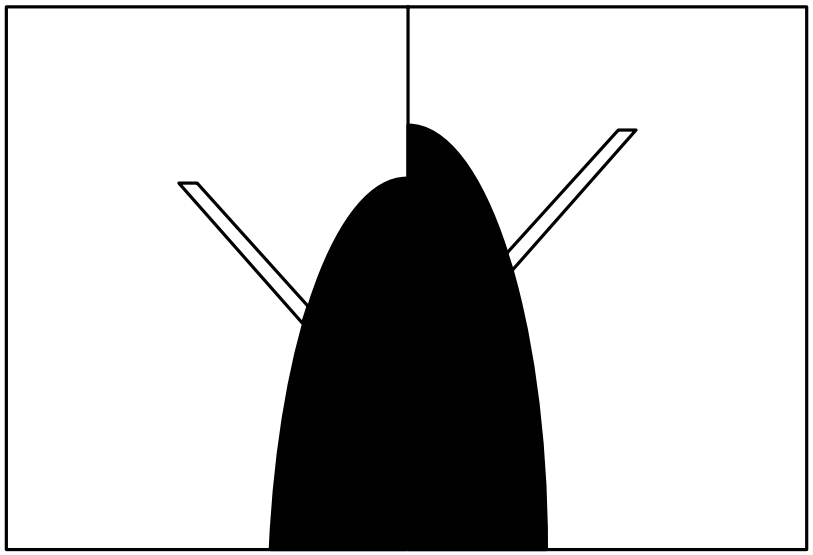
AutoGuide Functional Checks, *continued*

h. Compare the images to the correct and incorrect images shown below.

i. If the images are incorrect, see the **Targeting Calibration Procedure** in the Alignment and Calibration section.



Correct Image



Incorrect Image

Figure 6: Needle Image Position

Mammovision/Mammotest System Checks, *continued*

AutoGuide Functional Checks, *continued*

Checking Lateral Arm Targeting Accuracy

1. Ensure that the phantom setup has not changed from the previous section.
2. Attach the Lateral Arm to the patient left position.
3. Install the lateral needle guide holder and a standard 16 cm lateral approach calibration needle.
4. On the Mammovision screen, select:
   Lateral Approach
   This will convert the target information to the lateral left coordinates and transfer the new coordinates to the AutoGuide.
5. Select:
   Needle
6. Choose the needle description that matches the calibration needle being used.
7. Slide the needle back away from the phantom and move the AutoGuide to Target 1.
8. When the AutoGuide has finished moving, slide the needle forward until it reaches the arrow.
9. Verify that the center of the needle is in line with the tip of the arrow, and that the depth of the needle as read off of the AutoGuide rail matches the depth displayed on the monitor to within ±1 mm.
10. Record the results on the **Patient Left Position and Depth Accuracy Data** data sheet.
11. Slide the needle back away from the phantom and repeat **step 7** to **step 10** for Targets 2 and 3.
12. Attach the Lateral Arm to the patient right position.
13. On the Mammovision screen, select:
    Lateral Approach
    This will convert the target information to the lateral left coordinates and transfer the new coordinates to the AutoGuide.
14. Select:
    Needle
15. Choose the needle description that matches the calibration needle being used.
16. Slide the needle back away from the phantom and move the AutoGuide to Target 1.

Continued on next page

Mammovision/Mammotest System Checks, *continued*

AutoGuide Functional Checks, *continued*

17. When the AutoGuide has finished moving, slide the needle forward until it reaches the arrow.
18. Verify that the center of the needle is in line with the tip of the arrow, and that the depth of the needle as read off of the AutoGuide rail matches the depth displayed on the monitor to within ±1 mm.
19. Record the results on the **Patient Right Position and Depth Accuracy Data** data sheet.
20. Slide the needle back away from the phantom and repeat steps 16 to 19 for Targets 2 and 3.
21. If all targets are within ±1 mm for all approaches, the AutoGuide functional tests are complete. If a target is not within tolerance, adjust the trim values per the **Left Side Lateral Approach Trim Angle Calibration Procedure** and the **Right Side Lateral Approach Trim Angle Calibration Procedure** steps in the Alignment and Calibration section and repeat the Targeting Accuracy checks.

Mammovision/Mammotest System Checks, *continued*

Archiving and Retrieving Functional Test Data

These procedures are used to perform a backup and restore of the critical system calibration files. To perform these procedures, you must exit the Mammovision software and be at a DOS prompt.

Critical system calibration parameters that must be replaced when swapping computers include:

- CCD Zero Point Information
- System Parameters
- The next optical disk volume to use
- AEC information'
- Password Information
- Needle information
- Holder information
- default needle data
- default exposure method
- CCD defects
- Optical disk state (enabled/disabled)
- Network state (enabled/disabled)
- CCD output
- Digital laser interface (enabled/disabled)
- Trim angles
- Screen saver time-out
- camera serial number
- camera map information

Continued on next page

Mammovision/Mammotest System Checks, *continued*

Archiving and Retrieving Functional Test Data, *continued*

Backing up Mammovision data files to a ZIP disk

This procedure backs-up the following data to a ZIP disk:

- Patient Database and Images
- Physicist Database Files
- System Data Files

1. Exit the Mammovision software.
2. Pull up a DOS prompt.
3. Insert an empty formatted zip disk into the zip drive.
4. Type the following at the DOS prompt:
   XCOPY C:\ESS*.* D:\ESS*.* /S /E
   (C is the drive with the data and D is the zip drive)
5. Press the Enter key on the keyboard.
6. Type the following at the DOS prompt
   XCOPY C:\CCDMAP*.* D:\CCDMAP*.* /S /E
7. Press the Enter key on the keyboard.
8. Type the following at the DOS prompt
   XCOPY C:\ESS2*.* D:\ESS2*.* /S /E
9. Remove the zip disk from the drive and label it.

Restoring Mammovision data files from a ZIP disk

1. Exit the Mammovision software.
2. Pull up a DOS prompt.
3. Insert the zip disk with the data in the zip drive.
4. Type the following at the DOS prompt:
   XCOPY D:\ESS*.* C:\ESS*.* /S /E
   (C is the drive with the data and D is the zip drive)
5. Press the Enter key on the keyboard.
6. Type the following at the DOS prompt
   XCOPY D:\CCDMAP*.* C:\CCDMAP*.* /S /E
7. Press the Enter key on the keyboard.
8. Type the following at the DOS prompt
   XCOPY D:\ESS2*.* C:\ESS2*.* /S /E
9. Boot the Mammovision system and verify that the database is valid and that the system performs correctly.
10. Perform the **Mammovision Daily Calibration Check** procedure.

Logic and Block Diagrams

Athena Generator and System Logic Diagrams

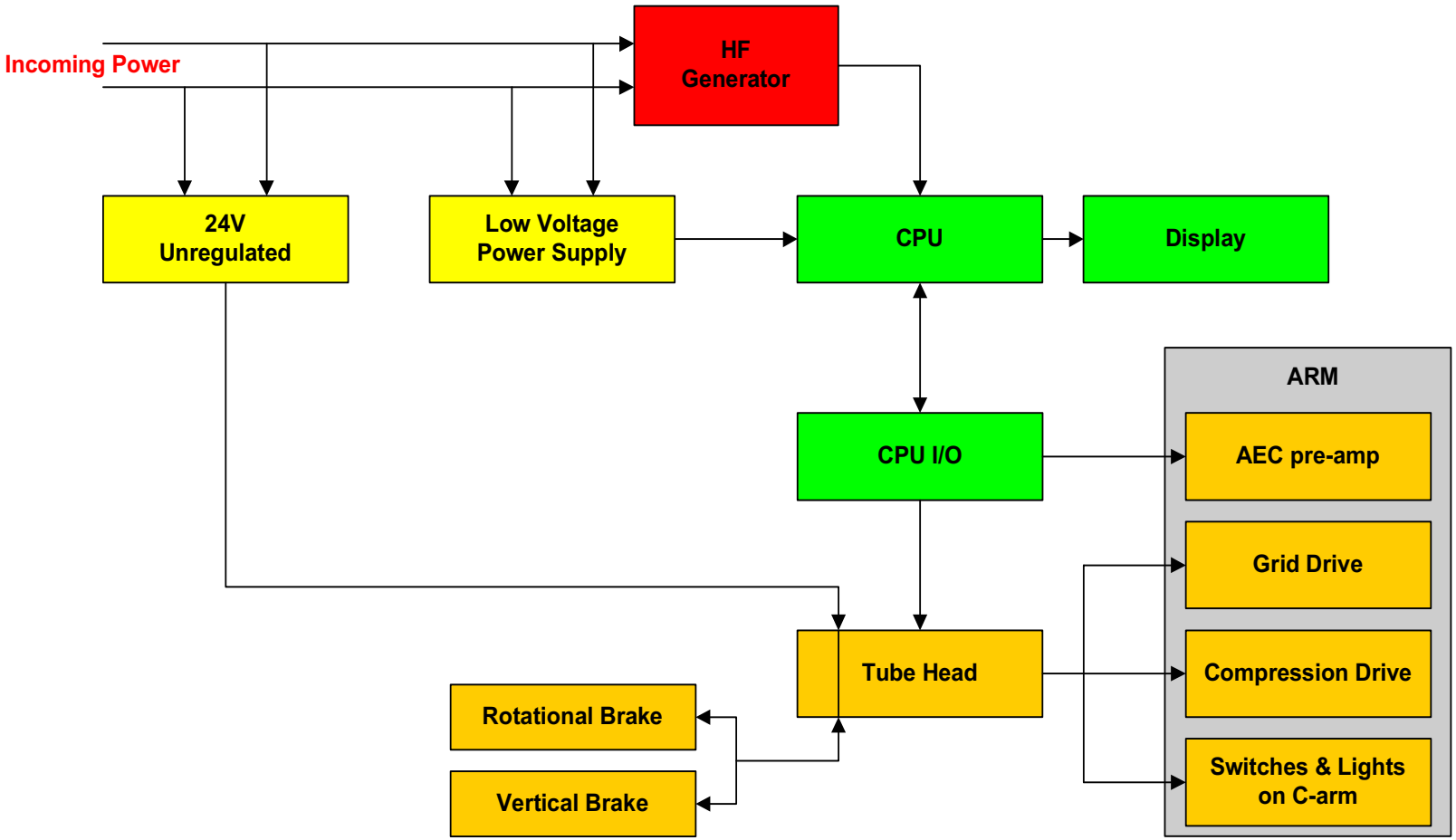
- Generator Functional Diagram
- Prep Command to Inverter Power Supply
- X-Ray Command to High Frequency Power Supply

Mammovision/Mammotest System Logic Diagrams

- Mammotest Plus Table Block Diagram
- Mammotest Plus/S Table Block Diagram
- Non-Surgical AutoGuide System Block Diagram
- Surgical AutoGuide System Block Diagram
- Mammovision System Block Diagram

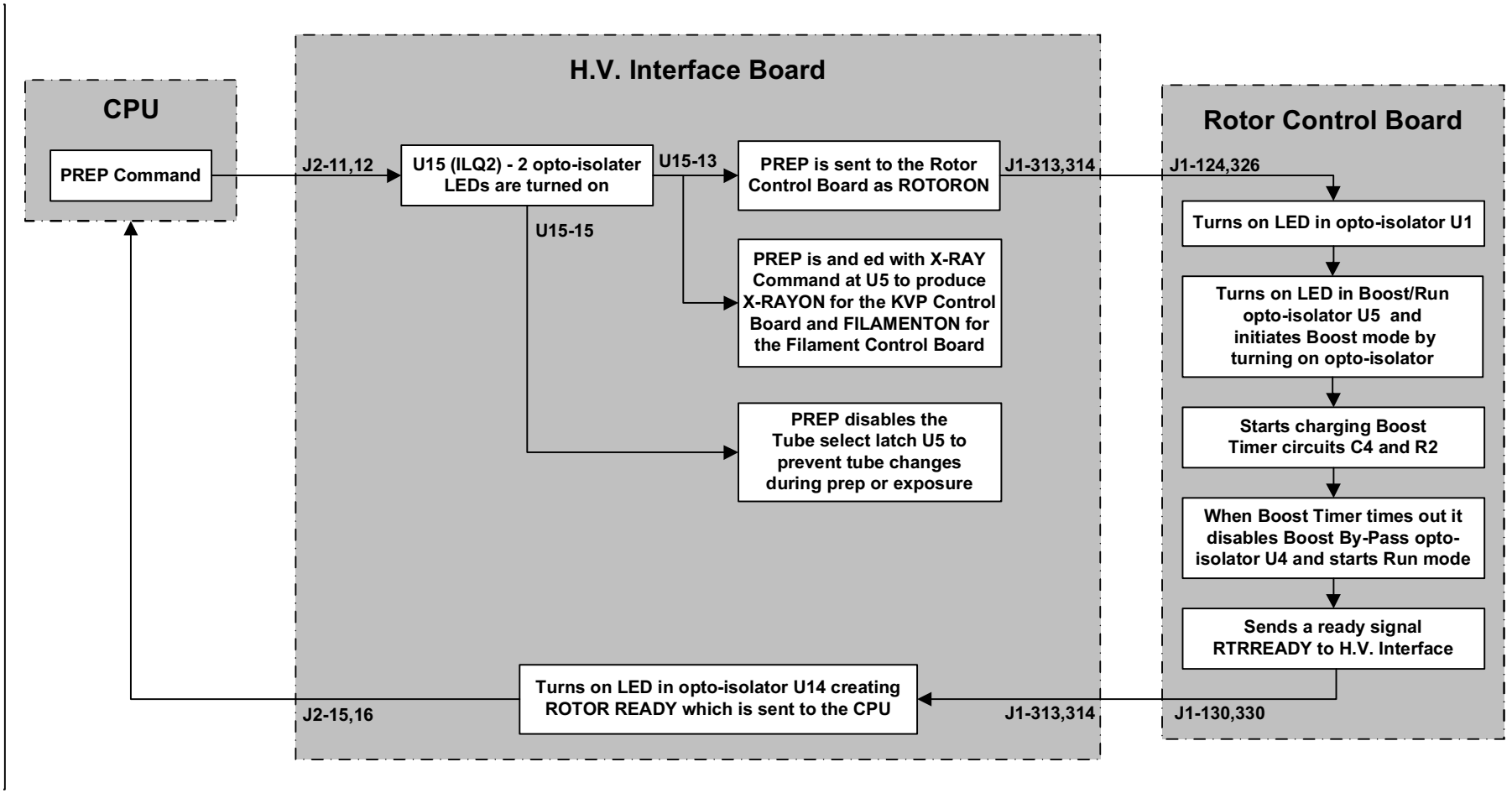
Athena Generator and System Logic Diagrams

Generator Functional Diagram



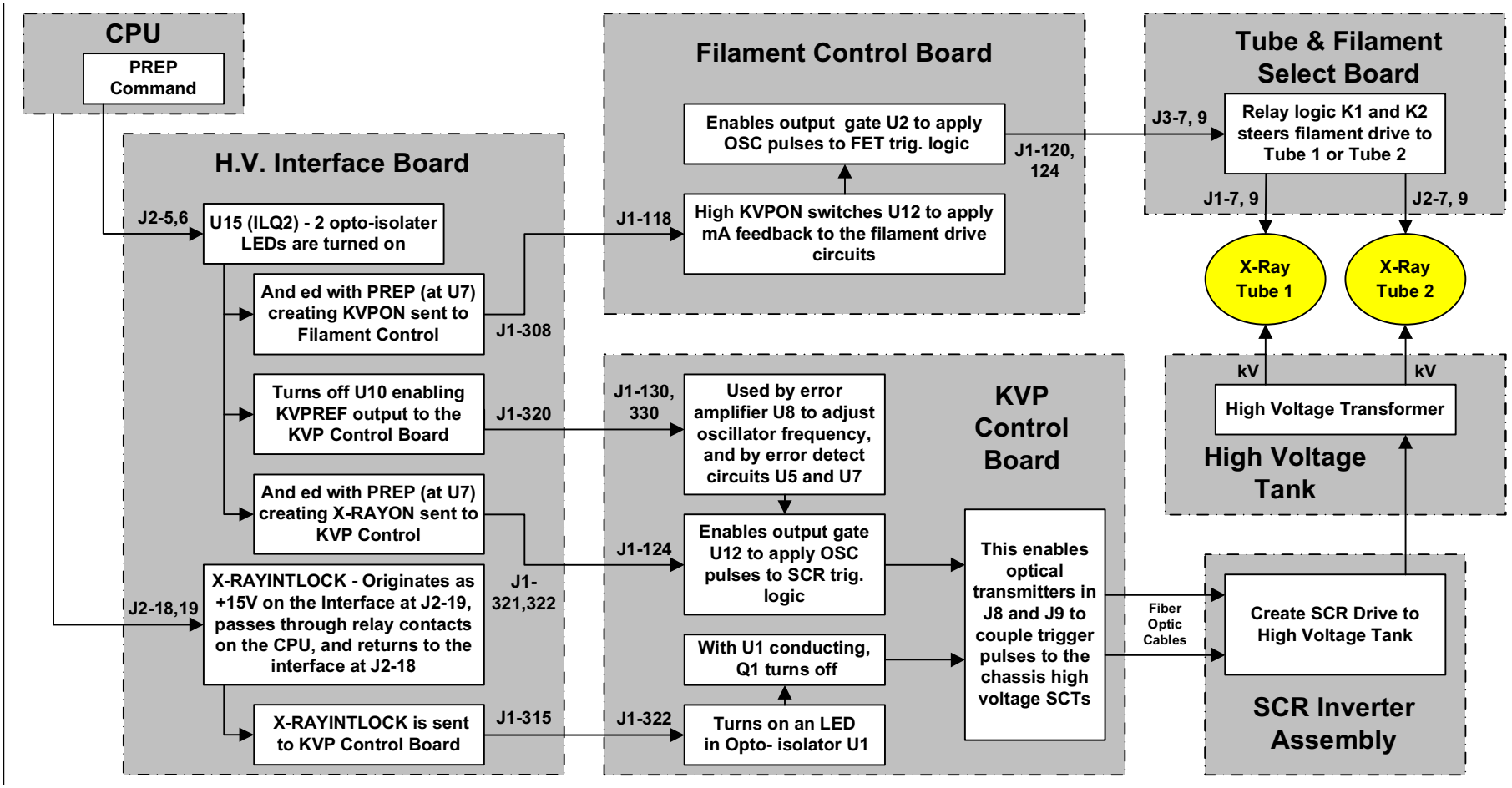
Athena Generator and System Logic Diagrams, *continued*

Prep Command to Inverter Power Supply


CPU
PREP Command
J2-11,12
H.V. Interface Board
U15 (ILQ2) - 2 opto-isolater LEDs are turned on
U15-13
PREP is sent to the Rotor Control Board as ROTORON
J1-313,314
U15-15
PREP is and ed with X-RAY Command at U5 to produce X-RAYON for the KVP Control Board and FILAMENTON for the Filament Control Board
PREP disables the Tube select latch U5 to prevent tube changes during prep or exposure
Turns on LED in opto-isolator U14 creating ROTOR READY which is sent to the CPU
J2-15,16
J1-313,314
Rotor Control Board
J1-124,326
Turns on LED in opto-isolator U1
Turns on LED in Boost/Run opto-isolator U5 and initiates Boost mode by turning on opto-isolator
Starts charging Boost Timer circuits C4 and R2
When Boost Timer times out it disables Boost By-Pass opto-isolator U4 and starts Run mode
Sends a ready signal RTRREADY to H.V. Interface
J1-130,330

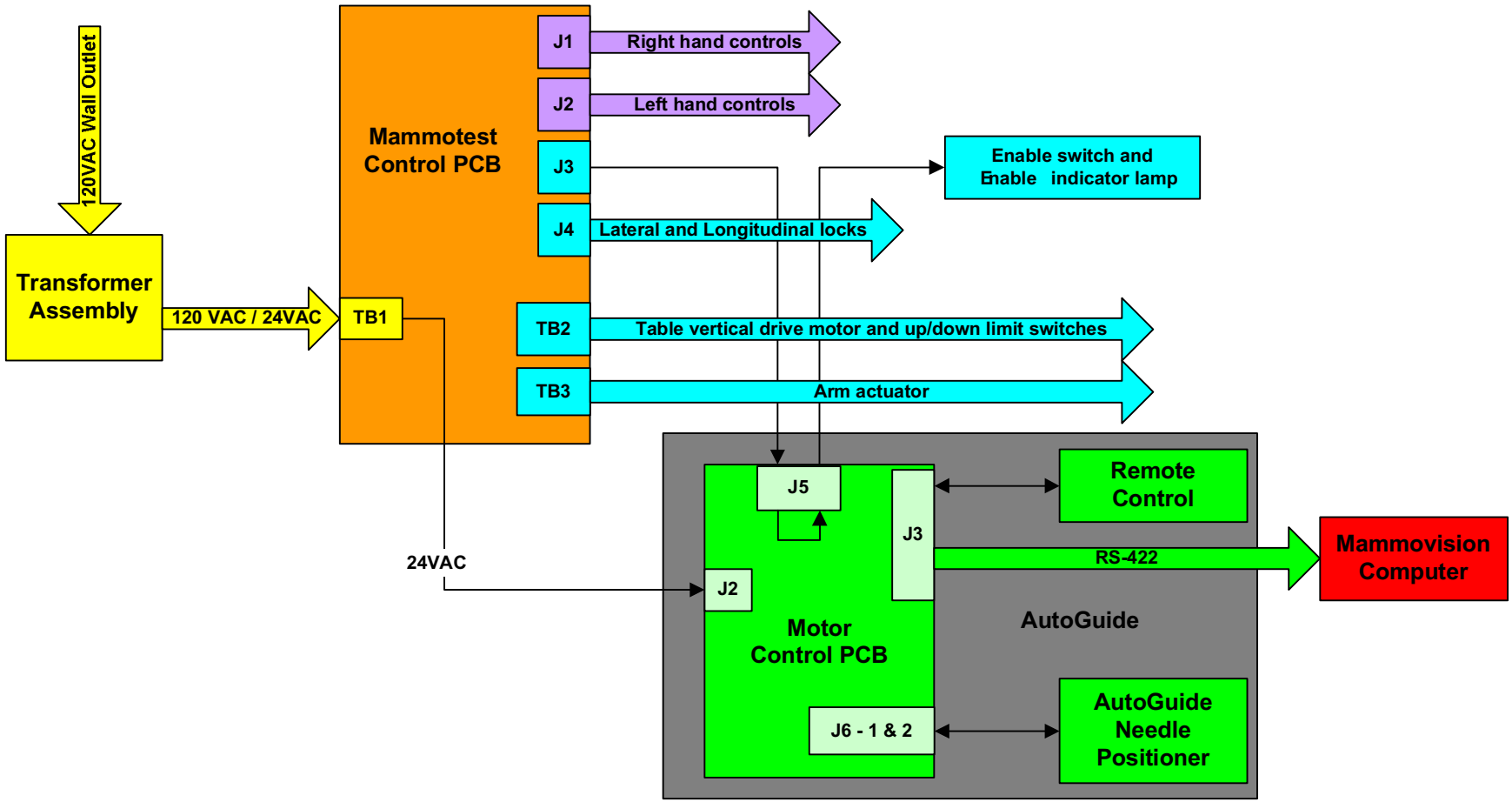
Athena Generator and System Logic Diagrams, *continued*

X-Ray Command to High Frequency Power Supply


CPU
PREP Command
H.V. Interface Board
J2-5,6
U15 (ILQ2) - 2 opto-isolater LEDs are turned on
And ed with PREP (at U7) creating KVPON sent to Filament Control
J1-308
Turns off U10 enabling KVPREF output to the KVP Control Board
J1-320
And ed with PREP (at U7) creating X-RAYON sent to KVP Control
J1-321,322
J2-18,19
X-RAYINTLOCK - Originates as +15V on the Interface at J2-19, passes through relay contacts on the CPU, and returns to the interface at J2-18
X-RAYINTLOCK is sent to KVP Control Board
J1-315
Filament Control Board
J1-118
High KVPON switches U12 to apply mA feedback to the filament drive circuits
Enables output gate U2 to apply OSC pulses to FET trig. logic
J1-120, 124
KVP Control Board
J1-130, 330
Used by error amplifier U8 to adjust oscillator frequency, and by error detect circuits U5 and U7
J1-124
Enables output gate U12 to apply OSC pulses to SCR trig. logic
With U1 conducting, Q1 turns off
J1-322
Turns on an LED in Opto- isolator U1
This enables optical transmitters in J8 and J9 to couple trigger pulses to the chassis high voltage SCTs
Fiber Optic Cables
Tube & Filament Select Board
J3-7, 9
Relay logic K1 and K2 steers filament drive to Tube 1 or Tube 2
J1-7, 9
J2-7, 9
X-Ray Tube 1
X-Ray Tube 2
kV
kV
High Voltage Transformer
High Voltage Tank
Create SCR Drive to High Voltage Tank
SCR Inverter Assembly

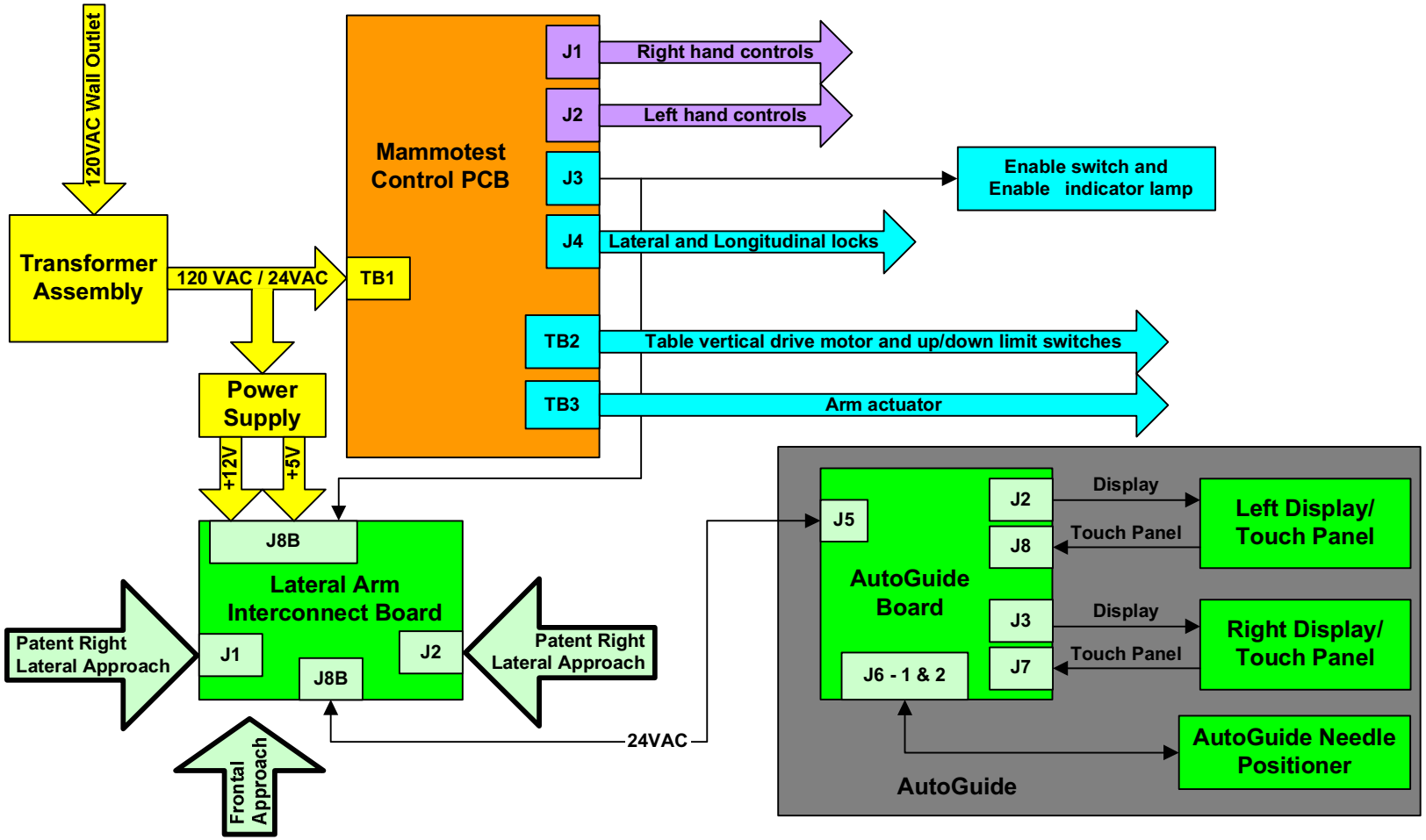
Mammovision/Mammotest System Logic Diagrams

Mammotest Plus Table Block Diagram



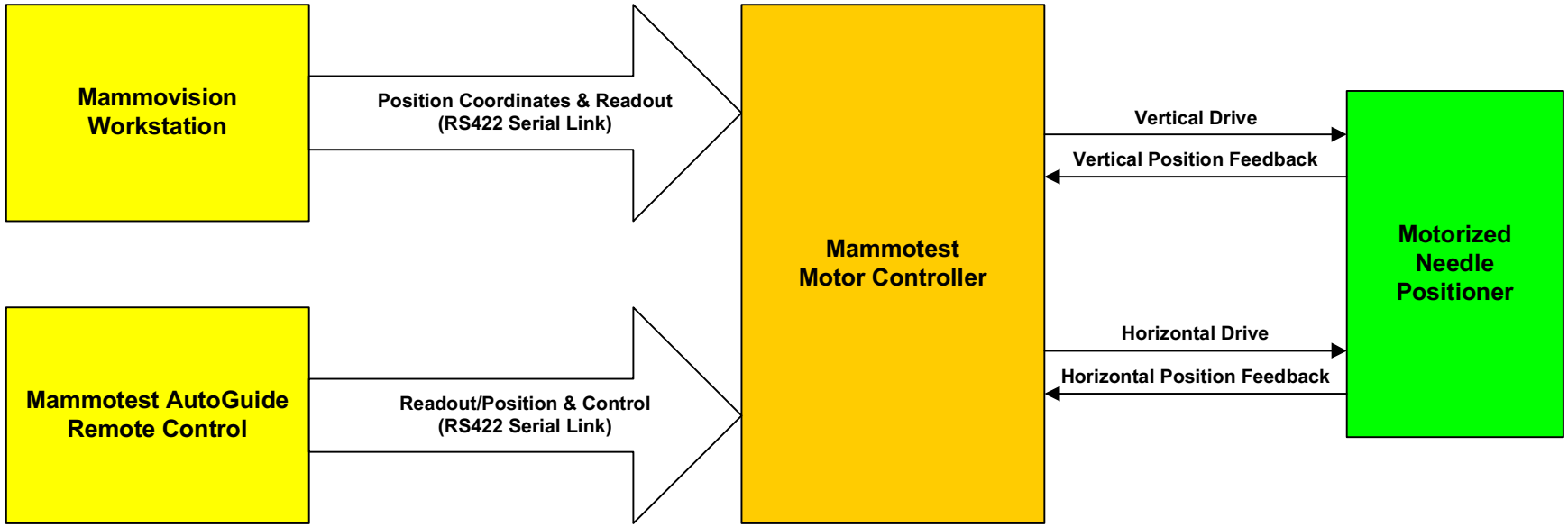
Mammovision/Mammotest System Logic Diagrams, *continued*

Mammotest Plus/S Table Block Diagram



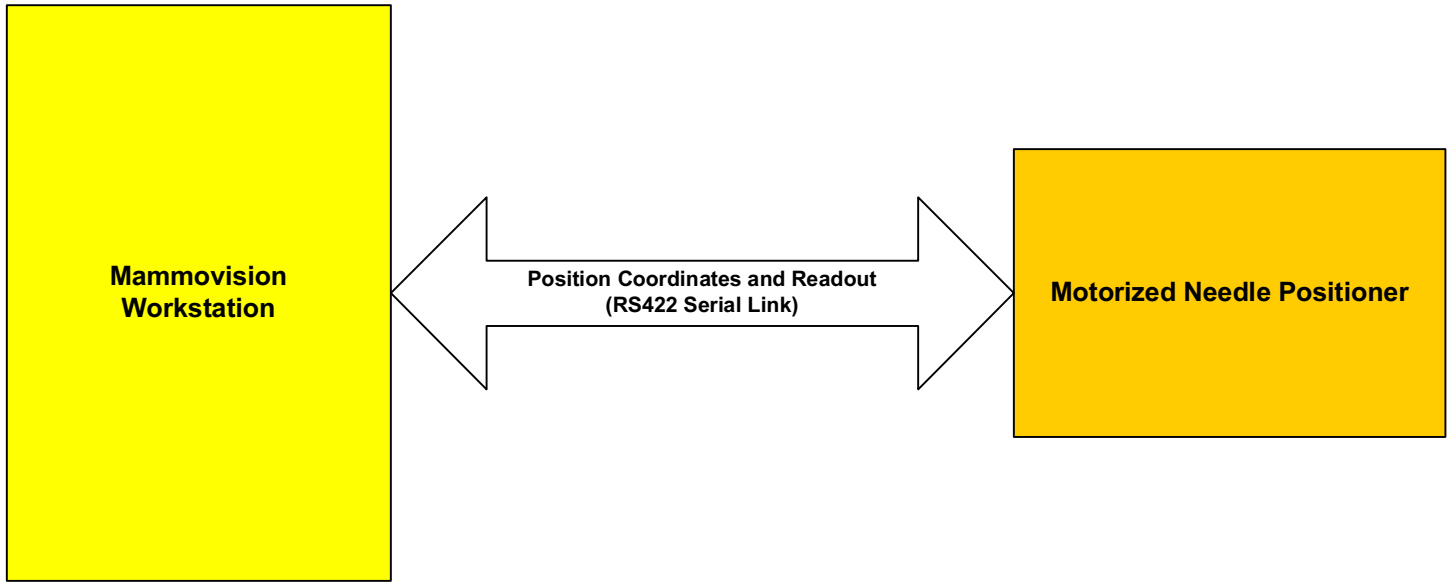
Mammovision/Mammotest System Logic Diagrams, *continued*

Non-Surgical AutoGuide System Block Diagram



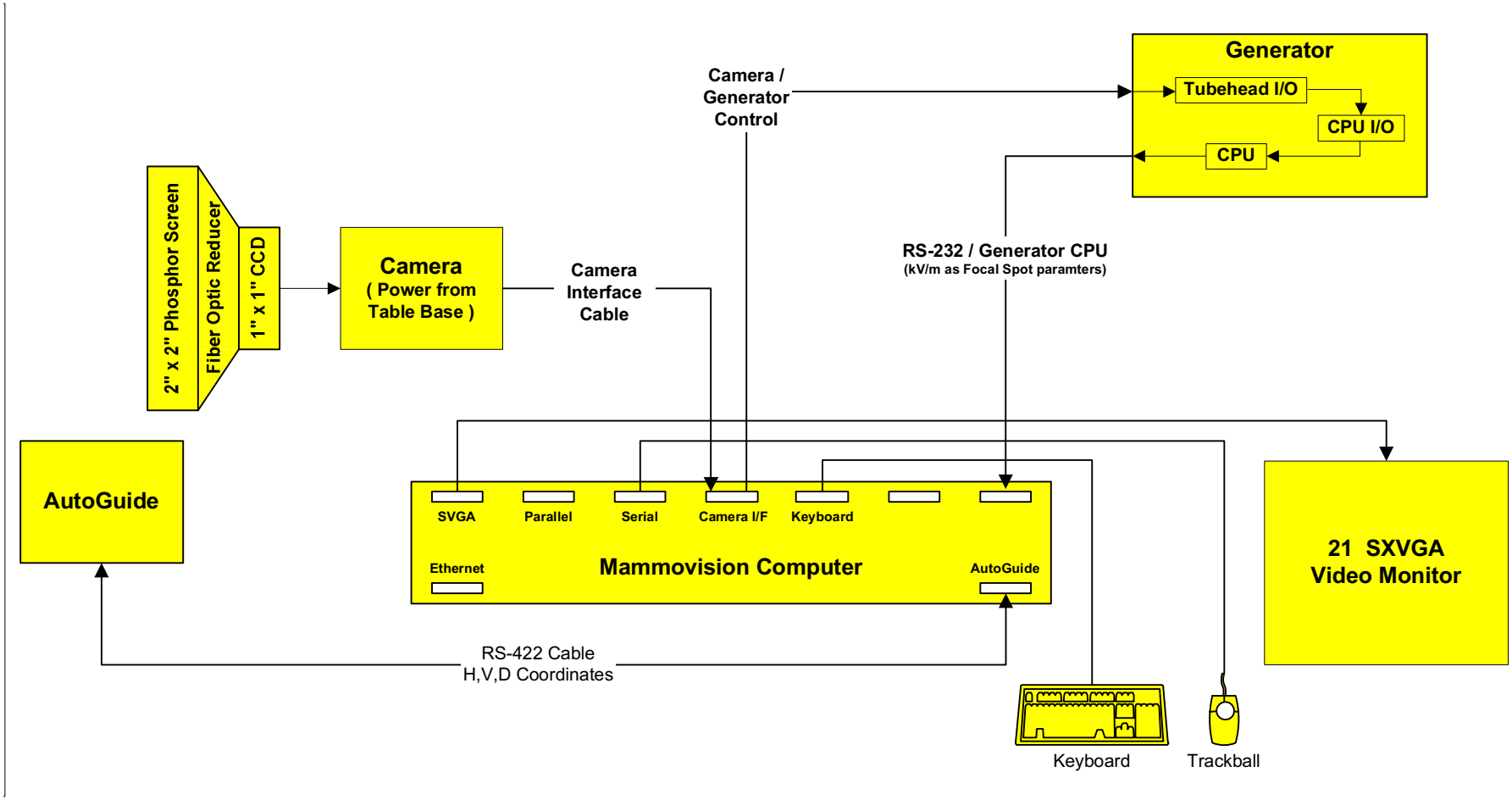
Mammovision/Mammotest System Logic Diagrams, *continued*

Surgical AutoGuide System Block Diagram



Mammovision/Mammotest System Logic Diagrams, *continued*

Mammovision System Block Diagram



PREVENTIVE MAINTENANCE

Athena Generator

- Periodic Service Maintenance
- Bucky Preventive Maintenance

Mammovision/Mammotest System

- Periodic Service Maintenance

Athena Generator

Periodic Service Maintenance

To ensure continuing compliance with the U.S. Department of Health and Human Services Regulations, these tests may be performed more frequently than the indicated maximum intervals. The service technician must conduct the tests pursuant to the requirements of part 1020.30 of Public Law 90-602.

Biannually (every 6 months)

- Perform all tests under the "**Athena HF Generator and System Checks**" heading in the "Functional Checks" section.
- Perform any alignment and calibration needed to maintain the equipment at or better than the required functionality

Bucky Preventive Maintenance

Bucky maintenance consists of regular cleaning and disinfecting with mild soap or alcohol solutions.

All internal parts are self-lubricating, so do not need oiling.

Avoid spilling or dripping liquids inside the Bucky.

Mammovision/Mammotest System

Periodic Service Maintenance

Annually

- Perform all tests under the "**Mammovision/ Mammotest System Checks**" heading in the "Functional Checks" section.
- Perform any alignment and calibration needed to maintain the equipment at or better than the required functionality

SOFTWARE AND DIAGNOSTICS

Mammotest/Mammovision Plus Firmware
- Mammotest Remote Control Firmware
- AutoGuide Motor Controller Firmware
- Mammovision Application Software

Mammotest/Mammovision Plus/S Firmware
- AutoGuide Control Software
- Mammovision Application Software

Mammotest/Mammovision Plus Firmware

At the time of publication, these are the most current part numbers. Before ordering parts, be sure to check the part numbers on the machine you are servicing and verify the appropriate replacement part numbers with the manufacturer.

Mammotest Remote Control Firmware

Board Part Number: 53556G

Board Location: U9

Device Part Number: 95653G

Revision: 1.1

AutoGuide Motor Controller Firmware

Board Part Number: 89468G-3

Board Location: U6

Device Part Number: 95657G-2

Revision: 2.93

Mammovision Application Software

Device Part Number: 95357G-9

Revision: 3.0

Mammotest/Mammovision Plus/S Firmware

At the time of publication, these are the most current part numbers. Before ordering parts, be sure to check the part numbers on the machine you are servicing and verify the appropriate replacement part numbers with the manufacturer.

AutoGuide Control Software

Device Part Number: 95429G-4

Revision: 1.3

Mammovision Application Software

Device Part Number: 95780G-9

Revision: 3.0

THEORY

Safety
- General Safety Precautions
- Electrical Safety

System Overview

Athena X-Ray Generator Operation
- System Initialization Mode
- System Standby Mode
- Command Processing Mode
- Error Processing Mode

Athena X-Ray System Functional Description
- Low Voltage Power Distribution Sub-System
- High Voltage Transformer Input Power
- High Voltage Transformer Secondary Output Power
- X-Ray Tube Stator Control
- 5kW High Frequency Power Supply
- Status Display Area

Mammovision Imaging System
- Mammovision Camera
- Mammovision Workstation
- Image Acquisition

MammoTest Plus & Mammotest Plus/S Table and Biopsy System
- General Theory of Operation
- Mammotest AutoGuide General Information
- Mammotest Non-Surgical AutoGuide
- Mammotest Surgical AutoGuide
- Lateral Approach Biopsy System

Safety

Always follow all safety procedures when operating or working on all Fischer equipment. This equipment contains high voltages that are hazardous if proper safety precautions are not followed. For maximum safety, always operate and service this system according to procedures specified inthis EPST and the manufacturers Operators Guide.

Before operating or servicing this equipment you must have a thorough knowledge of all operating controls, functions, and a basic knowledge of x-ray technology.

WARNING Some procedures in this EPST require the use of x-rays. Always use proper safety procedures when taking an x-ray exposure. You cannot feel, see, or hear radiation from an x-ray. Long-term exposure to low radiation levels may cause health problems.

Equipment safety procedures and potential hazards are emphasized by warnings and cautions in this EPST and the manufacturer's Operators Guide. It is absolutely essential that you are familiar with both documents before attempting to service the system.

General Safety Precautions

Always comply with the following general safety precautions:

- Procedures on this system should be performed only by properly authorized and qualified personnel.
- Do not operate the system unless you fully understand the safety considerations and procedures presented in this EPST.
- Make sure remote circuit breakers are off and tagged before working inside the equipment.
- Always know actions to be taken in an emergency situation.

Electrical Safety

Always use caution when working with the covers removed. 208 - 240 VAC line voltages are used as primary power. Primary wiring requires grounding conductors for all power feeds and neutrals with grounded conduits.

System Overview

The Fischer Athena HF and Fischer Mammotest/ Mammovision mammography systems feature modular components that can be used to build a complete mammography screening and minimally invasive biopsy system:

The Athena High Frequency Mammography System (Athena HF) is used for mammography screens, and includes:

- **Athena X-Ray Generator**
  The Athena x-ray generator is a high frequency, microprocessor-based x-ray generator.
- **Athena C-Arm**
  The Athena C-arm contains the X-ray tube, film cassette, and compression device. Biopsies are performed with the patient standing up.

A full featured biopsy system might include:

- **Athena X-Ray Generator**
  The Athena HF x-ray generator is a high frequency, microprocessor-based x-ray generator.
- **Mammovision Imaging System**
  Includes the CCD camera and a workstation to manipulate the images.
- **Mammotest Plus or Mammotest Plus/S**
  The Mammotest systems both include a table that allows the biopsy to be performed with the patient in a prone position.
  - The *Mammotest Plus* system also includes the Non-Surgical AutoGuide and needle holder for performing minimally invasive biopsies.
  - The *Mammotest Plus/S* system includes the Surgical AutoGuide and needle holder for performing biopsies that leave a wire guide for use in surgery.

Athena X-Ray Generator Operation

The Athena HF generator is a high frequency, microprocessor-based x-ray generator. It also provides:

- X-ray controls (kV, mA, mAs, etc.)
- High voltage transformer

A M147 molybdenum anode X-ray tube on a "film optimized," single post front end generates the x-rays.

The Athena x-ray generator has 4 operating modes:

Operating Mode	Description
System Initialization Mode	Checks system, loads defaults on power-up
System Standby Mode	Calibration changes, filter changes, and other system changes are performed in this operating mode
Command Processing Mode	Four types of commands are processed in this operating mode: • operating parameter change • x-ray prep sequence • x-ray prep "off" sequence • x-ray exposure sequence
Error Processing Mode	Hardware, operating parameter, and CompuTracII™ time-out errors are processed.

Continued on next page

Athena X-Ray Generator Operation, *continued*

System Initialization Mode

1. Initializes then clears I/O ports on the CPU board
2. Clears the generator control panel display, then shows the software version number in the mA window.
3. Checks non-volatile memory for valid data.
   If non-volatile memory data is corrupt, the memory is re-initialized with the default calibration data. During re-initialization, the value in the mA window counts from 1 to E.
   The data is again checked, and if re-initialization is successful, error E10 is displayed in the mA window. If re-initilization fails, error E11 is displayed.
4. Operating parameters and heat unit values for a cold x-ray tube are loaded, system errors are cleared, and default operating parameters are loaded.
5. Operating parameters are checked for legal combinations. If an illegal technique selection or incorrect filter position is detected, the Tube Overload indicator is lit.
6. The large filament is loaded with the standby current and checked. If no current is detected, error E21 displays in the mA window.

System Standby Mode

1. Monitors SW2 on the CPU board to determine generator state.

   The generator has 5 system states.
   SW1 and SW2, located on the CPU board, are used to change system state. SW1 selects the desired state, and pressing SW2 activates that state.

Table 16: System States

System State	Description
0	Standard Operating Mode
1	Calibration of kV, filament current, and boost current
2	Setting CompuTracII™ calibration tables
3	Calibration of Bucky drive relay
4	System configuration/Reload default parameters

2. Senses the position of the installed filter; if the filter position has changed, or if the filter has been removed, the operating parameters are rechecked.

Continued on next page

Athena X-Ray Generator Operation, *continued*

System Standby Mode, *continued*

3. Control panel activity is monitored, and the command processor is invoked when panel activity is detected.
4. The following software timing functions are verified:
   - display flashing
   - stator boost termination
   - compression paddle movement termination - "up"
   - cooling simulation parameter update for the x-ray tube
   - calibration mode - times if the system has been in calibration mode for longer than 5 minutes, without entering the x-ray prep sequence

Command Processing Mode

Four types of commands are processed in this operating mode:

Operating Parameter Change Command

Changes kV, mA, time, filament, and density parameters.

The parameter variable in the CPU is updated, than the display window is updated. The system then checks all parameters to verify that a legal combination has been selected, including.

- Maximum allowable signal exposure power
- Minimum allowable kV with respect to mA setting
- Maximum allowable kV
- kV compatibility with filter
- kV compatibility with CompuTracII^{TM} state selected
- X-ray tube overload will not occur with exposure specified by kV, mA, and time

Continued on next page

Athena X-Ray Generator Operation, *continued*

Command Processing Mode, *continued*

X-Ray Prep Sequence

To begin this sequence, the following conditions must be met:

- All system errors must be cleared
- A minimum time interval (based on generator type selection) must pass

1. The calibration timer is reset for 5 minutes.
2. The overload detection circuits on the filament control board, the beam board, the rotor board, and the interlocks are checked.
3. The filament current is set based on the specified exposure. If the current is less than 1 Amp, error E21 is displayed in the mA window.
4. The Prep/X-Ray button is checked. If the button is not pressed to the first catch, the prep sequence is aborted, and the prep "off" sequence begins.
5. The x-ray tube anode accelerates to 3600 rpm. After 0.8 seconds, the acceleration voltage switches to the normal run voltage.
6. The inverter is checked for on and ready signals.
7. The Prep/X-Ray button is checked again. If the button is not pressed to the first catch, the prep sequence is aborted, and the prep "off" sequence begins and the kVp control board is tripped.
8. The kVp control board is checked for faults.

X-Ray Prep "Off" Sequence

The X-Ray Prep "Off" Sequence is triggered when the Prep/X-Ray button is released or when an error occurs during the X-Ray Prep sequence.

The X-Ray Prep "Off" Sequence consists of the following steps:

1. The Ready light is extinguished.
2. If the system state is "0" (standard operating mode), the voltage maintaining anode rotation is turned off.
3. The filament current is reset to the standby value. (If no filament current is detected, error E12 is shown.

Athena X-Ray Generator Operation, *continued*

Command Processing Mode, *continued*

X-Ray Exposure Sequence

The x-ray exposure sequence is initiated by pressing the Prep/X-Ray button to the second catch. The x-ray exposure sequence consists of the following:

1. The following items are checked for errors:
   - Filament current: a filament current of less than 1 Amp generates error E21
   - Stator drive current: if no stator drive current is detected, error E22 is displayed
   - kVp control board: if a kVp board error is detected, error E23 is displayed

   If any of these errors are detected, the X-Ray Exposure Sequence is aborted.
2. If grid motion is enabled, the moving grid is started, and a short delay allows the grid to accelerate.
3. The minimum time between x-rays is set according to the following:
   - 10s if the exposure is mAs terminated
   - 15s if the exposure is CompuTracII™ terminated
   - 16s if the grid drive is enabled
4. The Prep/X-Ray button is checked. If the button is not pressed to the second catch, the exposure sequence is aborted.
5. The number of mA pulses needed (including exposure tail compensation) is calculated.
6. The X-Ray indicator light in the status display area is lit.
7. The x-ray power is turned on and the x-ray beeper sounds.

Athena X-Ray Generator Operation, *continued*

Error Processing Mode

This system process 3 types of errors in this mode:

- Hardware Errors
  Hardware errors are displayed in the mA window of the generator. If a hardware error is detected during the x-ray prep sequence, the x-ray prep "off" sequence is triggered. When the hardware error is cleared, the system initilization sequence is begun.
- Operating Parameter Errors
  Operating parameter errors, such as an illegal combination of operating parameters, are indicated by the "Tube Overload" lights. The x-ray prep sequence will not begin until the operating parameter error is fixed.
- CompuTracII™ Time-Out Errors
  A time-out error is indicated by a flashing reset button. In addition, the operator's console displays the remaining time and mAs that would have completed the exposure. Pressing the reset button clears this error and returns the system to the previous operating mode.

Athena X-Ray System Functional Description

The Athena X-ray system is made up from the following sub-systems:

- **Low Voltage Power Distribution Sub-System**
- **High Voltage Transformer Input Power**
- **High Voltage Transformer Secondary Output Power**
- **X-Ray Tube Stator Control**
- **5kW High Frequency Power Supply**
- **Status Display Area**

Low Voltage Power Distribution Sub-System

The power distribution sub-system draws power from the main power line (208/220/240 VAC) and distributes it via the low voltage distribution transformer.

The input is fused with two KTK, 25A fuses (F1 and F2).

Input power is selected via jumper at TB2.

- Line (10) to 9 on TB2 = 240 VAC
- Line (10) to 8 on TB2 = 220 VAC
- Line (10) to 7 on TB2 - 208 VAC

The outputs from this transformer include:

- **18VAC - Isolated**
  Fused at 15A (F7 and F8 on the primary power panel)
  Powers the 24VDC unregulated power supply and the collimator lamp
- **120 VAC - Non-Isolated**
  Fused at 15A (F5 and F6 on the primary power panel)
  Used as an input to the regulated DC power supplies and used by the CPU board to sense system shutdown

Continued on next page

Athena X-Ray System Functional Description, *continued*

Low Voltage Power Distribution Sub-System, *continued*

- **24VDC - Unregulated - Isolated (PS1)**
  Fused at 15A through the 18VAC line
  Used for relays on the moving grid drive board, AEC Board and the I/O board, for the vertical and rotation brakes, for the grid drive and for the auto compression drive
- **5VDC - Non-Isolated**
  Fused at 3A (F9 on the primary power panel)
  Used on the CPU for general digital logic power (this power never leaves the CPU board
- **±15VDC - Non-Isolated (PS2)**
  Fused at 1A (F10, F11 on the primary power panel)
  Used on the CPU board for analog input and output power, on the AEC board, and on the input side of the opto-isolated op-amp on the Filament control board.
- **+24VDC - Regulated - Non-Isolated (PS3)**
  Fused at 2.5A (F12 on the primary power panel)
  Used on the CPU board for general purpose interfacing and lighting the status display area.

High Voltage Transformer Input Power

The input frequency to the high voltage transformer is varied to set the x-ray tube kV.

SCRs connected in series with the high voltage transformer primary windings control the x-ray. When the SCRs are triggered, power reaches the transformer primary windings, initiating the high voltage transformer secondary output.

High Voltage Transformer Secondary Output Power

The primary input voltage is stepped up by a factor of about 150, rectified into DC voltage, and filtered with a 0.15 µf capacitor.

The "+" side of this voltage is connected to the x-ray tube anode

The "-" side of this voltage is connected to the mA input terminal on the Filament Control Board with a pair of banana plugs. (The banana plugs can be separated, and a mA meter connected between them to measure current at the x-ray tube.) Current to the x-ray tube is precisely measured by the Filament control board and fed back to the CPU board.

Athena X-Ray System Functional Description, *continued*

X-Ray Tube Stator Control

The x-ray tube stator is controlled by the rotor control board. Normal rotation is maintained at approximately 60V, and acceleration occurs when approximately 208V is applied to the stator windings. The stator winding voltage is monitored by the rotor control board, and a fault of E22 indicates an absence of voltage at the stator.

5kW High Frequency Power Supply

The 5kW high frequency, switching mode power supply provides 20-39kV high voltage and 0-125mA current to the x-ray tube upon command from the system CPU and interface board. The power supply includes the following:

- High Voltage and Filament Power Supplies
- HV Interface Board
- Filament Control Board
- Rotor Control Board
- KVP Control Board
- Tube and Filament Select Board
- Two Optical SCR Trigger Boards
- Two HF Current Transformer Boards
- Motherboard
- Chassis Mounted Rectifier Set, Monitoring Circuits and Relays
- Status Display Area

Athena X-Ray System Functional Description, *continued*

5kW High Frequency Power Supply, *continued*

High Voltage and Filament Power Supplies

These power supplies are both high frequency resonant mode switching supplies, which means that they achieve output regulation by varying the switching frequency and fixing the power switch on and off times. The High Voltage supply uses SCRs as power switches, while the Filament supply uses FETs.

HV Interface Board

The HV Interface board controls when an x-ray exposure is allowed, and the duration, current and voltage of that exposure. The HV interface board must receive the "SYSTEM READY," "FILAMENT READY", "KVP READY," and "ROTOR READY" signals before initiating an exposure. In addition, any fault signals at the CPU will be monitored by the HV interface board, and will prevent an exposure.

To initiate an x-ray, the HV interface board first receives a "PREP" signal from the CPU. The HV interface board does 3 things in response to the "PREP" signal:

- Generates the "ROTORON" signal to activate the rotor
- Inhibits the tube select circuits
- Allows the "X-RAY ON" signal (the "X-RAYON" signal must be preceded by the "PREP" signal before an exposure will take place)

When the HV interface board receives an "X-RAY ON" signal from the CPU, it sends a "KVPON" signal to the Filament control board, and an "X-RAYON" signal to the KVP control board.

Athena X-Ray System Functional Description, *continued*

5kW High Frequency Power Supply, *continued*

Filament Control Board

The filament control board performs 5 main functions as follows:

- Regulates filament current based on the "FILEREF" signal from the CPU
- Monitors filament current and sends this information back to the CPU.
- Adjusts the filament drive current based on the existing tube or filament current compared to the Interface Board signal.
- Controls the FET drive circuitry and output current in two ways - During an exposure, the filament control board compares the reference voltage from the CPU to the feedback signal from the transformer current, and during standby and prep, the filament control board compares the reference voltage to the filament current.
- Detects faults caused by filament overcurrent, filament undercurrent and tube current above a preset level.

Rotor Control Board

The Rotor Control board uses 240 VAC to drive the x-ray tube rotor to a speed of 3600 rpm within one second, then maintain that speed. The signal from the rotor control board is directed to the selected x-ray tube via the Tube& Filament Select board.
The Rotor control board sequences the x-ray tube rotor through 4 states:

- Off (during standby)
- Boost (during "PREP")
- Run (during exposure)
- Brake (after exposure)

KVP Control Board

The KVP Control board regulates the generator high voltage output based on the reference voltage from the CPU. The high voltage output is regulated by controlling the power SCRs on the primary side of the high voltage transformer.

Tube and Filament Select Board

Receives the signal from the rotor control board and directs it to the selected x-ray tube.

Athena X-Ray System Functional Description, *continued*

5kW High Frequency Power Supply, *continued*

Motherboard

Supplies +24VDC to the HV Interface board and the Optical Trigger boards, and also supplies the rest of the chassis boards with ± 15VDC.

Chassis Mounted Rectifier Set, Monitoring Circuits and Relays

One chassis rectifier supplies 330VDC to the Filament Control board, while a second chassis rectifier supplies +550VDC to the SCRs from the three phase 380VAC supply.

Status Display Area

The status display board is a buffer for the logic signals to and from the CPU.

Mammovision Imaging System

The Mammovision system is a filmless imaging system for stereotactic biopsy procedures in mammography. It captures the x-ray and can process and display the image on a high resolution monitor within 4 seconds of the exposure.

The Mammovision system consists of two subsystems:

- **Mammovision Camera**
- **Mammovision Workstation**

Mammovision Camera

The Mammovision camera replaces the screen-film casette holder on traditional mammography machines. The Mammovision camera features:

- High resolution 1024 x 1024 pixel matrix covers 50 x 50mm image field (50µm pixels)
- Full frame, scientific grade, front illuminated, MPP mode CCD camera
- Direct coupling to an x-ray intensifying screen via a 2:1 fiber optic reducer
- Digitized in slow-scan, correlated, double sampling mode
- 500k pixels/second and 12-bit contrast resolution

Mammovision Workstation

The Mammovision workstation features:

- Pentium, IBM compatible computer
- 2100 megabyte hard disk (holds up to 900 images for temporary storage)
- 21" monitor with 1280 x 1024 pixel, high resolution display and contrast resolution of 4096 gray levels
- Trackball
- Keyboard
- Optical (ZIP) 100 Mbyte ATAPI internal drive allows archiving of 45 images per ZIP disk
- Icon driven software with image manipulation capabilities such as contrast enhancement and zoom
- Patient database software for record management

Options include:

- Multi-Format camera kit
- ACR-NEMA PACS network interface (Dicom 3.0)
- Laser printer interface

Continued on next page

Mammovision Imaging System, *continued*

Mammovision Workstation, *continued*

The Mammovision camera and workstation communicate via the serial interface (camera interface) board.

The serial interface board acquires the camera data and transfers it to the workstation. In polled mode, the software continuously polls the status register and manipulates the control register of the serial interface board to control the x-ray and camera.

Image Acquisition

Automatic Exposure Control Option

Because of the flexibility of the mammovision system, the dynamic range of the detector, and the ability to adjust the contrast and brightness of the image on the video display, a wide range of exposure levels will produce an acceptable image. To standardize image quality and to minimize the x-ray exposure of the patient, the Automatic Exposure Control (AEC) can be used to terminate the exposure automatically when the camera reaches a desired light level. During x-ray exposure, the Mammovision computer monitors the signal level in the serial register. When the desired signal level is reached, the x-ray exposure is terminated.

AEC settings are determined by averaging two raw and two dark images during calibration (see **Mammotest/ Mammovision Alignment and Calibration** in the Alignment and Calibration section)

Mammovision Imaging System, *continued*

Image Acquisition, *continued*

Image Acquisition Procedure

When the operator presses the "Expose" button to the second catch, the following steps are performed to acquire the image:

1. The generator sends /X-REQUEST to the status register on the serial interface board.
   In response, the Mammovision computer calculates the time required for the camera to stabilize, then sends
   X_GEN_RDY (high)
   /AEC_TERM (high)
   FIFO_RST (low), and
   REQ_INT (high)
   via the control register on the serial interface board.
2. The camera sends CAM_RDY (high) to the status register of the serial interface board. In response, the computer sends CCD_READY (low) to the generator via the control register on the serial interface board.

Note If the camera's CAM_RDY bit remains low, the serial interface board will contain CAM_ERR in the status register. In response, the Mammovision computer will send
/X_GEN_RDY (low) and
/AEC_TERM (low)
to the generator via the control register on the serial interface board.

3. While the camera status remains CAM_RDY (high), the camera begins filling the FIFO buffer with x-ray data. The computer monitors /EF (low) and /HF (high) in the status register.
   When /EF (low) changes to /EF (high), the Mammovision sends REQ_INT (low) to the control buffer, then reads the data in the FIFO buffer. When the data is read, /EF (high) changes to /EF (low), the camera begins filling the FIFO buffer again, and camera operation continues in this loop until the exposure is terminated.

Continued on next page

Mammovision Imaging System, *continued*

Image Acquisition, *continued*

4. Exposure is terminated by the computer when using the Automatic Exposure control, or manually when using the Manual Exposure control.

   - **Automatic Exposure Control**
     The data acquired is used to determine when the exposure is complete. When the AEC limit is reached, the computer sends
     STOP_EXP (high) and
     AEC_TERM (low)
     to the control register of the serial interface board. In response, the serial interface board sends
     STOP_OUT (high) to the camera
     /FIFO_RST (high) to stop integration
     VALID_DATA (high) for read-out mode
     The Mammovision computer then monitors /HF, which switches from (high) to (low), to indicate when to begin reading the final image data from the FIFO buffer. When CAM_RDY and /EF switch from (high) to (low), readout is complete.

   - **Manual Image Acquisition**
     When manual image acquisition is selected, the Mammovision computer ignores the automatic exposure control (AEC) data. Camera operation continues until the generator terminates the exposure based on the mA setting.
     When /X_REQUEST switches from (low) to (high), the Mammovision computer sends STOP_EXP (high) to the control register of the serial interface board. In response, the serial interface board sends:
     STOP_OUT (high) to the camera
     /FIFO_RST (high) to stop integration
     VALID_DATA (high) for read-out mode
     The Mammovision computer then monitors /HF, which switches from (high) to (low), to indicate when to begin reading the final image data from the FIFO buffer. When CAM_RDY and /EF switch from (high) to (low), readout is complete.

MammoTest Plus & Mammotest Plus/S Table and Biopsy System

General Theory of Operation

The Mammotest system takes two images at different angles and calculates the angles and depth necessary to direct the AutoGuide to the desired object. Used properly, the Mammotest system can be used to locate a target with an accuracy of ±1.0mm.

The images are taken at +15° and -15° along the x-axis of a given object. When the two images are compared, the object shows up in different places along the horizontal axis and at the same level on the vertical axis.

Using the Mammovision software, the clinician can designate the center of the object on both images, and the computer will calculate the three dimensional coordinates of the object.

Mammotest AutoGuide General Information

The AutoGuide is an automatic biopsy needle guidance system that uses a three dimensional, polar coordinate positioner. Horizontal and vertical motion is motorized, while depth is controlled with a mechanical depth stopper. The horizontal and vertical accuracy is ±0.1°, while the depth accuracy is ±0.5 mm.

A precision DC motor and gear mechanism, with limit switches at each extreme, drive the horizontal and vertical positioning. Depth is manually set using the mechanical needle stop.

An optical sensor monitors the needle positioning and provides a centering pulse, and an optical encoder provides incremental feedback to the motor controller.

The AutoGuide can be configured to use several different needles and needle holders; however the geometry of the needle holder and the length of the needle must be specified in the Mammovision software. For details on how to set these parameters see **Entering Needle Holder and Needle Data in the Mammovision** in the Alignment and Calibration section.

MammoTest Plus & Mammotest Plus/S Table and Biopsy System, *continued*

Mammotest Non-Surgical AutoGuide

The Non-surgical AutoGuide uses 5 subassemblies:

- **Mammovision Workstation**
- **Mammotest Motor Controller** -
  This obtains the position coordinates from the workstation via a serial data link and controls the horizontal and vertical DC motors in the AutoGuide Needle Positioner.
- **AutoGuide Needle Positioner** -
  This uses two DC motors to position the biopsy needle guide and provides feedback to the motor control.
- **AutoGuide Remote Control** -
  The remote control allows the clinician to initiate movement to the coordinates calculated by the Mammovision workstation or to move the needle position manually. Needle position is monitored via the 32 character LED display.

Mammotest Motor Controller

The Mammotest motor controller can receive coordinate information from 2 places: from the Mammovision workstation or from the AutoGuide remote control. The motor controller then drives the positioner motors to the specified coordinates (horizontal and vertical only) and provides positional data to the remote control display.

Note The Mammotest motor controller will only receive data from the remote control when the "Enable" button is pressed.

Communication is occurs between the motor control, remote control and Mammovision workstation via a Dual Asynchronous Universal Transmitter/Receiver (DUART). The motor control CPU also provides a bi-directional RS232 diagnostic port which is used for factory checkout and diagnostic purposes.

Both the horizontal and vertical motor controllers are normally initialized with the high level initial conditions data such as velocity constants, acceleration constants, PID filter and sample period with each new patient.

Continued on next page

MammoTest Plus & Mammotest Plus/S Table and Biopsy System, *continued*

Mammotest Non-Surgical AutoGuide, *continued*

When the motor controller CPU reads the position coordinates on the data bus AD0-AD7 via the DUART U11, it calculates the motor control values and sends the appropriate data to the vertical and horizontal motor control sections. Each motor control section calculates the actual motor drive voltages needed and provides the motor drive to it's respective motor through an H-bridge circuit.Each motor control section then monitors the encoder feedback from the positioner and adjusts the drive voltage as the target position nears. Typically the motor voltage will ramp up to start, hold a constant velocity, then ramp down to stop as the target coordinates are reached.

The Motor Controller CPU (8032) contains internal RAM and can also use the external RAM in the U15 (8155) device to store operating and debug data. The U15 device provides input port lines to monitor fourteen status bits and a six bit dip switch.

The fourteen status bits represent data on:

- ± limit switches (+horizontal, -horizontal, +vertical, -vertical)
- current limit (ILMT) from each axis (+horizontal, -horizontal, +vertical, -vertical)
- home switch for each axis (+horizontal, -horizontal, +vertical, -vertical)
- +5V (+5ENC) power supply monitoring
- +24V (+24VOK) power supply monitoring

In addition, a reset circuit (U23) provides a motor controller CPU reset at power on. This circuit also monitors program execution by counting pulses and resets the motor controller CPU if pulses stop (software lockup suspected).

AutoGuide Needle Positioner

The AutoGuide needle Positioner sees two DC motors to position the biopsy needle guide and provides feedback to the motor control.

AutoGuide Remote Control

The remote control allows the clinician to initiate movement to the coordinates calculated by the Mammovision workstation or to move the needle position manually. Needle position is monitored via the 32 character LED display.

MammoTest Plus & Mammotest Plus/S Table and Biopsy System, *continued*

Mammotest Surgical AutoGuide

The Surgical AutoGuide operates in the same way as the non-surgical AutoGuide, except?

Lateral Approach Biopsy System

The Lateral Approach Biopsy system is used to obtain a biopsy of thinly compressed breast tissue with lesions located near the breast support. The lateral approach eliminates concerns of striking the breast plate with the needle, and can also minimize the needle travel distance for some lesions.

The Lateral Approach Biopsy System features:

- Lateral Arm
- Lateral Needle Guide Holder
- Lateral Left and Lateral Right AutoGuide positioner connectors
- Lateral Arm Interconnect circuit board
- Motor Control Board (Plus system only)
- Motor Control Firmware (Plus system only)
- Mammovision workstation software

Lateral Arm

The lateral arm is mounted at a right angle on either side of the Mammotest compression arm, with the AutoGuide positioner on the same horizontal plane as the frontal approach AutoGuide. In the "Home" position, the center of the AutoGuide positioner rail is 1 cm from the surface of the breast support, which is the minimum distance it was designed for.

An alignment fixture is used to minimize variations in the adapter bracket and arm assembly mounting. Alignment must be performed after installation and at any time that the alignment of the arm is suspect. In addition to the physical alignment, minor adjustments can be made to the trim angle and depth in the software to increase targeting accuracy.

MammoTest Plus & Mammotest Plus/S Table and Biopsy System, *continued*

Lateral Approach Biopsy System, *continued*

Lateral Needle Guide Holder

The lateral needle guide holder must be used with the Lateral Arm. This needle guide is narrower and provides more support to the needle. The narrower design allows the needle guide to move past the breast support, while the more stable needle support helps guide the needle to the proper location despite encountering more uncompressed tissue or traveling through more tissue than is typical for a frontal approach biopsy.

Lateral Left and Lateral Right AutoGuide Positioner Connectors

The Lateral Left and Lateral Right AutoGuide Positioner Connectors provide a separate connection for each approach, which reduces external cabling and allows the motor control board and Mammovision workstation to detect which approach (frontal, right, or left) is being used.

Mammovision Workstation Software

The Mammovision software calculates the coordinates based on the approach selected. This allows the operator to move the AutoGuide positioner to any approach during a procedure, as long as the coordinates are re-calculated after the AutoGuide has moved.

TROUBLESHOOTING

Athena HF Generator and System Troubleshooting
- General Problems
- Performance Problems
- High Voltage Problems

Mammovision/Mammotest System Troubleshooting
- General Problems
- Monitor Problems
- Image Quality Problems

Athena HF Generator and System Troubleshooting

Three classes of problem are included:

- **General Problems**, which include:
  - **Blank Display at Power Up**
  - **Initial Display Values and Lights are Incorrect**
  - **Display Button Errors**
- **Performance Problems**, which include:
  - **kV Sag**
  - **mAs Too High**
  - **mA Sag**
  - **Grid Lines on Film**
  - **Inconsistent CompuTracII Exposures**
- **High Voltage Problems**

To troubleshoot the Athena HF, first isolate the subsystem causing the problem, then refer to the information here and in the **Error Codes** section for possible symptoms and solutions.

Continued on next page

Athena HF Generator and System Troubleshooting, *continued*

General Problems

Blank Display at Power Up

Possible Causes	Diagnostic Checks
• No power to the CPU board • The CPU board is not running • The control board is disconnected from the CPU board • The displays are not receiving power from the regulated +24V power supply	1. Check that 120 VAC is present at the power supply. 2. Check the incoming power to the CPU board. 3. Check the CPU board LEDs. Indicators such as the AEC Reset LED should be on even if the CPU board is not running. 4. Check that U46 - the software - is properly socketed in the CPU board. 5. Check the 50-pin cable between the CPU board (A2J4) and the control board (H1J1). 6. Replace the CPU board.

Continued on next page

Athena HF Generator and System Troubleshooting, *continued*

General Problems, *continued*

Initial Display Values and Lights are Incorrect

On power-up, the initilization values displayed and the LED lit are incorrect. Pressing buttons also causes incorrect responses. Random digits and lights appear.

Possible Causes	Diagnostic Checks
• Incorrect software in the CPU board • A CPU board fault in the display driver logic • A CPU board fault that causes the board to remain in "Reset" mode (when operating normally, the generator initilization will take about 1/2 second).	1. Check the software on the CPU board. 2. Replace the CPU board.

Display Button Errors

Display buttons do not function or cause intermittent or rapid change in parameters.

Possible Causes	Diagnostic Checks
• A bad switch on the control board • A CPU board fault in the display driver logic	1. Unplug the control board and measure the switch resistance between contacts with the switch open and closed. 2. Replace the CPU board.

Athena HF Generator and System Troubleshooting, *continued*

Performance Problems

kV Sag

The kV appears to sag or display a sawtooth shape during the exposure when measured with a drop tank and oscilloscope.

Possible Causes	Diagnostic Checks
• The drop tank is not grounded. This causes an electric charge to build up on the drop tank case through current leakage, which affects the drop tank voltage measurement. • The oscilloscope is not set up properly.	1. Check the drop tank grounding 2. Check the oscilloscope set-up; e.g. check that the probe input is DC coupled.

mAs Too High

The measured mAs appear to be too high.

Possible Causes	Diagnostic Checks
• A broken or shorted wire within the high voltage transformer • A faulty mAs meter • Faulty wiring in the high voltage secondary circuit between the mA terminal and ground	1. Check continuity of the high voltage secondary circuit to the - mA terminal and through the filament control board ground 2. Check mAs with a second mAs meter 3. Check for high voltage problems (see section "High Voltage Problems")

Continued on next page

Athena HF Generator and System Troubleshooting, *continued*

Performance Problems, *continued*

mA Sag

The tube mA appears to sag during the x-ray exposure.

Possible Causes	Diagnostic Checks
• The tube may be wearing out if this happens during a low kV exposure. • The oscilloscope is not set up properly.	1. Check the mA calibration at high mA and low kV. 2. Verify the age and amount of use on the x-ray tube. Replace the tube as needed. 3. Check the oscilloscope set-up; e.g. check that the probe input is DC coupled.

Grid Lines on Film

Grid lines appear on the film when using the moving grid option.

Possible Causes	Diagnostic Checks
• The grid is not moving	1. Check that the Bucky is receiving power, and that it initialized properly (the green LED is on when the cassette is inserted). 2. Check that the signal to start the grid in motion is being sent (check the status LED on the CPU board) and that the Bucky is receiving that signal.

Continued on next page

Athena HF Generator and System Troubleshooting, *continued*

Performance Problems, *continued*

Inconsistent CompuTracII Exposures

The CompuTracII exposures are inconsistent with regard to density and image quality.

Possible Causes	Diagnostic Checks
• The detector is not properly placed completely beneath the breast. The detector should not be positioned beneath either edge of the cassette. • The CompuTracII sensitivity was set without the grid, and the exposure was taken with the grid or vice versa. • The CompuTracII setup was based on a different film than is currently being used • An inappropriate technique has been used for the exposure • The radiation detector is faulty • The connection between the radiation detector and the AEC pre-amp board is faulty. • The AEC pre-amp board is faulty. • The film processor is working improperly • The kV calibration is off.	1. Check that good imaging procedures are being used. 2. Re-calibrate the CompuTracII sensitivity using the same imaging procedures used at this site. 3. Replace the AEC pre-amp board. 4. Replace the CompuTracII radiation detector. 5. Check operation of the film processor.

Athena HF Generator and System Troubleshooting, *continued*

High Voltage Problems

High voltage problems are typically caused directly or indirectly by a voltage ark and the resulting energy surge.

Symptoms of high voltage problems include the following:

- The display locks up or blanks during the "Prep" sequence, which may cause error 10 to display when the unit is restarted. This symptom can also occur if the -mA terminal is not properly grounded. To determine if this is a high voltage problem, eliminate the following problems:
  - Check that the mA plug has not been left out with no mAs meter is attached.
  - Check the fuse on the mAs meter attached to the system.
  - Check the transformer for a broken wire.
  - Check the oil level in the high tension transformer.
- The display locks up, displays random character or blanks during an exposure, which may cause error 10 to display when the unit is restarted.
- An audible snap is heard during an x-ray exposure.
- The x-ray exposure stops prematurely.
- The kVp control board trips and error 23 is displayed (probably from too much current to the high voltage transformer).
- Error 21 is displayed during an exposure. This may be due to an arc between the tube anode and the filament, which disrupts the filament current measurement circuit.
- Error 28 is displayed, indicating too much current
- Spikes or other abnormalities are seen in the kV or mA waveforms.

Continued on next page

Athena HF Generator and System Troubleshooting, *continued*

High Voltage Problems, *continued*

Typically high voltage problems occur due to a fault in the high voltage transformer, cables, the x-ray tube or the circuit from the -mA terminal to ground on the high voltage transformer.

To diagnose high voltage problems, check for the following:

- Check that the high voltage cable is well grounded.
- Check that the drop tank and the secondary high voltage cable are well grounded.
- Check that the x-ray tube is in good condition and is not too hot.
- Listen to the high voltage transformer. High voltage problems in the tank or drive board can often be heard.
- Check that the high voltage transformer tank is filled with oil.

Mammovision/Mammotest System Troubleshooting

General Problems

Use the following general troubleshooting procedure to identify Mammovision system problems.

1. Power the system up. If the system does not power up, check for computer board seating and incoming power problems.
2. Check that the system can acquire a dark image.
3. Check that the system can acquire an x-ray image. If error E36 appears on the generator, check for camera problems.
4. Check that the timing signals are functioning correctly as follows:
   a. Change the system state to 4 to disable the Mammovision
   b. Take an x-ray exposure
   c. If the exposure is OK, check the communications between the generator and the Mammovision.
   d. Reset the system state to enable the Mammovision.
   e. Observe the three timing signal LEDs on the CPU I/O board.
      – "Coll Sense 2" lights when the x-ray request signal is sent to the system interface board
      – "Aux Sense 1" lights when the CCD ready signal is received from the system interface board
      – "Aux Sense 2" lights when the AEC terminate signal is received and the x-ray stops.
5. Perform the procedures in the "Functional Checks" section to test that the RMS value is between 4 and 8 when using the following setup:
   - acquire an 0.8s dark image
   - define a 200 x 200 pixel box
   - select "Stat"

   If the RMS value is out of range by less than 16, check all ground connections and check the camera power supply voltages.

Mammovision/Mammotest System Troubleshooting, *continued*

Monitor Problems

1. Reset the Mammovision system.
2. Check that the Mammovision logo displays. If it does, the following components are operating correctly:
   - the SVGA display board
   - the monitor screen
3. Isolate the monitor display board by pressing CTRL-X while acquiring an image. This will display the factory test images. If abnormalities such as black dots or pixels are observed on these images, replace the display board. If these images display well, check the CCD camera and the system interface board.

Image Quality Problems

1. At the Mammovision screen, select
   Analysis
   Get Images
   Acquire Corrected
   Exposure Control
   Standard
   Store A
2. Activate the generator's AEC.
3. Place the RMI phantom so that the upper left corner of the phantom is visible to the camera. Secure the phantom with the compression paddle.
4. Select technique factors:
   25 kV
   100 mA
   750 mAs
5. Make an exposure.
6. Select technique factors:
   26 kV
   100 mA
   750 mAs
7. Make a second exposure.

Continued on next page

Mammovision/Mammotest System Troubleshooting, *continued*

Image Quality Problems, *continued*

8. Score the images as follows:

   a. Score the fibers:
   Add 1 point for each full length fiber visible with the correct orientation and location
   Add 0.5 point for each fiber where half or more of the fiber is visible in the correct orientation and location
   Subtract 1 point for each full length fiber-like artifact visible, but not in the correct location or orientation
   Subtract 0.5 point for each fiber-like artifact where half or more of the fiber-like artifact is visible, but not in the correct orientation and location

   b. Score the speck groups:
   Add 1 point for each speck group where 4 or more of the specks are visible and in the correct location.
   Add 0.5 points for each speck group where 2 or 3 specks are visible in the correct location.
   Subtract 1 point for each speck group artifact where 4 or more specks are visible in an incorrect location
   Subtract 0.5 point for each speck group artifact, where 2 or 3 specks are visible in an incorrect location.

   c. Score the masses:
   Add 1 point for every mass where the density difference is visible in the proper location and the full circular edge of the mass is visible against the background.
   Add 0.5 point for every mass where the density difference is visible in the proper location, but the full circular edge of the mass is not visible.
   Subtract 1 point for every mass artifact where a density difference and full circular edge is visible in the incorrect location
   Subtract 0.5 point for every mass artifact where a density difference and partial circular edge is visible in the incorrect location

   d. Total the scores from a through c above.

Continued on next page

Mammovision/Mammotest System Troubleshooting, *continued*

Image Quality Problems, *continued*

9. At the Mammovision screen, select
   Cancel
10. Remove the RMI phantom.
11. Compare the score from step d above to the score obtained at the functional check performed at installation (recorded on the **RMI Model 156 Mammographic Accredation Phantom (1-25 kV) Data** data sheet). If the current score is less than half of the score recorded at installation, test the individual image acquisition components.

How to Use this EPST

Select a topic:

Acrobat Reader 4.0 Controls

Linking and Navigation

Adding Your Personal Notes

Printing

About This EPST

Acrobat Reader 4.0 Controls

Here are some shortcut keystrokes for Acrobat Reader 4.0:

[HOME] takes you to the first page of the EPST.

[PAGE UP], [PAGE DOWN]. and [END] work as titled.

[CTRL][←] takes you back to the previous display.

[CTRL][N] allows you to select a specific page number.

[F5] toggles the Bookmark display. Click on a Bookmark to go there.

[F6] toggles the Thumbnail display.

Linking and Navigation

On the bottom of every page, you will find a linking tool bar. Click on the section's icon to take you to that section. In addition to the linking toolbar on each page, you will find other links throughout the EPST.

Convention	Link
Blue text	Takes you to supplemental information about that topic.
See logic diagram XX	Takes you to the specified logic/ block diagram.
A	Links to another area on the same block/logic diagram. **Note** Not all of these have an active link; they are linked only when you need information you cannot see on a particular part of a diagram.

For additional navigation options, you may use the Acrobat Reader bookmark feature. To display bookmarks:

1. Press [F5] or click on the PageWithLeftMargin button on the Acrobat tool bar to open the Bookmark window.
2. Click on the section or page listed in the Bookmark window that you wish to view.
3. Press [F5] or click on the PageWithLeftMargin button to close the Bookmark window.

Adding Your Personal Notes

To add your personal notes:

1. Click on the Notes icon.

   A Word document opens.

2. Use the [TAB] key to navigate through the tables.
3. Type in the corresponding EPST page number and your notes.
4. When you finish making your notes, save the file and close Word.
5. To access your Notes, simply return to the EPST and click on the Notes icon at the bottom of any page.

Important! Personal Notes cannot work if you move the file; the path is hard-coded into the EPST. Personal Notes may not work when the computer is networked.

Printing

To print, perform the following actions.

1. On the Acrobat toolbar, select **File**, **Print**.
2. Select whether to print all pages, only the current page, or a range of pages. (Default is Print All Pages.)
3. Enable the "Shrink to Fit" option when printing the 11" x 17" block diagrams on 8.5" x 11" paper.
4. Click on **OK** to begin printing.

About This EPST

- The EPST is not intended to replace OEM system documentation. It also does not cover every problem or situation you may encounter while working on the system. There are probably many situations in which it may be helpful to refer to OEM system documentation.
- The link icons located at the bottom of every page usually take you to the first page of that section. When a link icon takes you to a specific reference, the link icon on the destination page will generally take you to the first page of that section.
- The setup program will create a Word document for your notes. The file is located at:
  `c:\mvdi\epst_notes\fc1019\persnote\notes.doc`
  - Personal Notes cannot work if you move the file; the path is hard-coded into the EPST.

Self-Paced Training Modules

Currently there is no self-paced training associated with this EPST.

REFERENCE MATERIALS

Preliminary Inspection Data
System Configuration Information
Test Equipment Data
mAs Data
Radiographic kV/mA Data
Linearity and Reproducibility Data
Beam Quality Half Value Layer Data
Transmission Limit Data Sheet
Light-defined X-Ray Field Contrast Data
Illumination of Light Localization Data
Leakage Radiation from Diagnostic Source Data
Gain Adjustment and Reproducibility Data for the CompuTracII
Density Compensation Verification Data
Density Control Verification
Back-Up Termination Verification Data
Auto kV Step Verification Data
RMI Model 156 Mammographic Accreditation Phantom Data for Film 1 (24 kV)
RMI Model 156 Mammographic Accreditation Phantom for Film 2 (25 kV)
RMI Model 156 Mammographic Accreditation Phantom for Film 3 (26 kV)
RMI Model 156 Mammographic Accreditation Phantom for Film 4 (23 kV)
RMI Model 156 Mammographic Accreditation Phantom for Film 5 (24 kV)
RMI Model 156 Mammographic Accreditation Phantom Scoring
Mammovision System Configuration Information
Mammovision Test Equipment Information
Mammotest Table Test Data
Automatic Exposure Control Data
RMI Model 156 Mammographic Accredation Phantom (1-25 kV) Data
AEC Reproducibility Data
Positioner Motion Test Data
Frontal Approach Position and Depth Accuracy Data
Patient Left Position and Depth Accuracy Data
Patient Right Position and Depth Accuracy Data
Software Data Values
Needle and Needle Holder Data
Sample Needle Holder Reference Points

Preliminary Inspection Data

Inspection

Condition	Yes
1. System meets sales order specifications	
2. System checked for proper general appearance	
3. Test equipment connections checked	

Basic System Functions

Condition	Yes
4. Vertical motion operation	
5. Compression Operation (Manual/Auto)	
6. Rotational Operation	
7. Turn On, Diagnostics, Techniques	
8. Control Panel Operation	
9. Collimator Lamp Operation	

Mechanical Operation

Comments:

Operation with X-Ray

Condition	OK?
10. Prep Operation	
11. Exposure Operation	

Preliminary Inspection Data, *continued*

Incoming Line Inspection:

Line Voltage Nominal: _____

Line Voltage No Load: _____

Load (25kV, 100mA): _____

Load (25kV, 125mA): _____

$$PercentRegulation = \frac{100 \times (V_{NoLoad} - V_{Load})}{V_{Load}}$$

Condition	Yes
1. Regulation (less than 6%) Exposure 1	
2. Regulation (less than 6%) Exposure 2	

Instantaneous Power Tube Overload

Condition	Yes
1. Allowable	
2. Tube Overload indicator comes on	

System Configuration Information

General Information

Tested by:	
Date:	
Hospital:	
Job Number:	
Dealer/Branch:	

Athena HF X-Ray System Information

Component	Serial Number	CDRH Label
Athena HF		
X-Ray Tube		
Beam Limiting Device P/N		
HV Generator P/N		
Access P/N		

Test Equipment Data

Test Equipment	Serial Number
Oscilloscope	
Dynalyzer III System (if applicable)	
• Display/Printer	
• Interface Box	
Dosimeter, Keithley Model 35020 (or equivalent)	
VOM	
mAs Meter, Fluke 8000A or equivalent	
Densitometer	

mAs Data

Table 17: Exposure Selection

Exposures	Select kV	Select mA
1 through 5		
6 through 10		

Table 18: Exposure Data

Exposure Number	Select mAs	Actual mAs	mAs Limit
1	20		18.6 to 21.4
2	30		28.4 to 31.6
3	50		48.0 to 52.0
4	70		67.6 to 72.4
5	90		87.2 to 92.8
6	100		97.0 to 103.0
7	140		136.2 to 143.8
8	180		175.4 to 184.6
9	200		195.0 to 205.0
0	280		273.4 to 286.6

Specification:

Manufacturing	±(1% of indicated + 1 mAs)
Field	±(2% of indicated + 1 mAs)
Stated	±(3% of indicated + 1 mAs)

Radiographic kV/mA Data

Table 19: kV/mA Data Part 1

		Select kV (kV Limit)							
		25 (22 to 26)		28 (26 to 30)		33 (31 to 35)		39 (37 to 41	
Select mA (Limit)	Select mAs	Actual kV	Actual mA	Actual kV	Actual mA	Actual kV	Actual mA	Actual kV	Actual mA
125 (114.25 to 135.75)	10								
100 (91.00 to 109.00)	60								
25 (21.25 to 28.75)	6								
15 (11.95 to 18.05)	10								

Specification:

Manufacturing	±(1% of indicated + 1 mAs)
Field	±(2% of indicated + 1 mAs)
Stated	±(3% of indicated + 1 mAs)

Radiographic kV/mA Data, *continued*

Table 20: kV/mA Data Part 2

		Select kV (kV Limit)							
		25 (22 to 26)		28 (26 to 30)		33 (31 to 35)		39 (37 to 41	
Select mA (Limit)	Select mAs	Actual kV	Actual mA	Actual kV	Actual mA	Actual kV	Actual mA	Actual kV	Actual mA
125 (114.25 to 135.75)	70								
100 (91.00 to 109.00)	200								
25 (21.25 to 28.75)	20								
15 (11.95 to 18.05)	35								

Specification:

Manufacturing	±(1% of indicated + 1 mAs)
Field	±(2% of indicated + 1 mAs)
Stated	±(3% of indicated + 1 mAs)

Radiographic kV/mA Data, *continued*

Table 21: kV/mA Data Part 3

		Select kV (kV Limit)			
		26 (24 to 28)		27 (25 to 29)	
Select mA (Limit)	Select mAs	Actual kV	Actual mA	Actual kV	Actual mA
30 (25.9 to 34.1)	9				
30 (25.9 to 34.1)	21				

Specification:

Manufacturing	±(1% of indicated + 1 mAs)
Field	±(2% of indicated + 1 mAs)
Stated	±(3% of indicated + 1 mAs)

Linearity and Reproducibility Data

No Load (V_N)	Select Set 1			Select Set 2			Select Set 3			Select Set 4		
Line Regulation: less than 6% +1 mean variance	kV			kV			kV			kV		
	mA			mA			mA			mA		
	mAs			mAs			mAs			mAs		
Exposure	**Actual Set 1**			**Actual Set 2**			**Actual Set 3**			**Actual Set 4**		
	Load	**%**	**mR**	**Load**	**%**	**mR**	**Load**	**%**	**mR**	**Load**	**%**	**mR**
1												
2												
3												
4												
Average % and mR												
Average mR/mAs												
Standard Deviation												
≤0.80	**Linearity**						**Linearity**					
≤0.80	**Variance**			**Variance**			**Variance**			**Variance**		

Beam Quality Half Value Layer Data

The following exposures are made at
30kV, 100mA, and 100 mAs

	Actual kV	Measured Dose - Unfiltered	Actual kV	Measured Dose - 0.2mm AL Filter	Actual kV	Measured Dose - 0.3mm AL Filter	Actual kV	Measured Dose - 0.4mm AL Filter
Exp. 1								
Exp. 2								
Exp. 3								
Exp. 4								
Total								
Ave. mR				*		*		*
		÷ 2						
Ave. Unfiltered Dose/2		**						

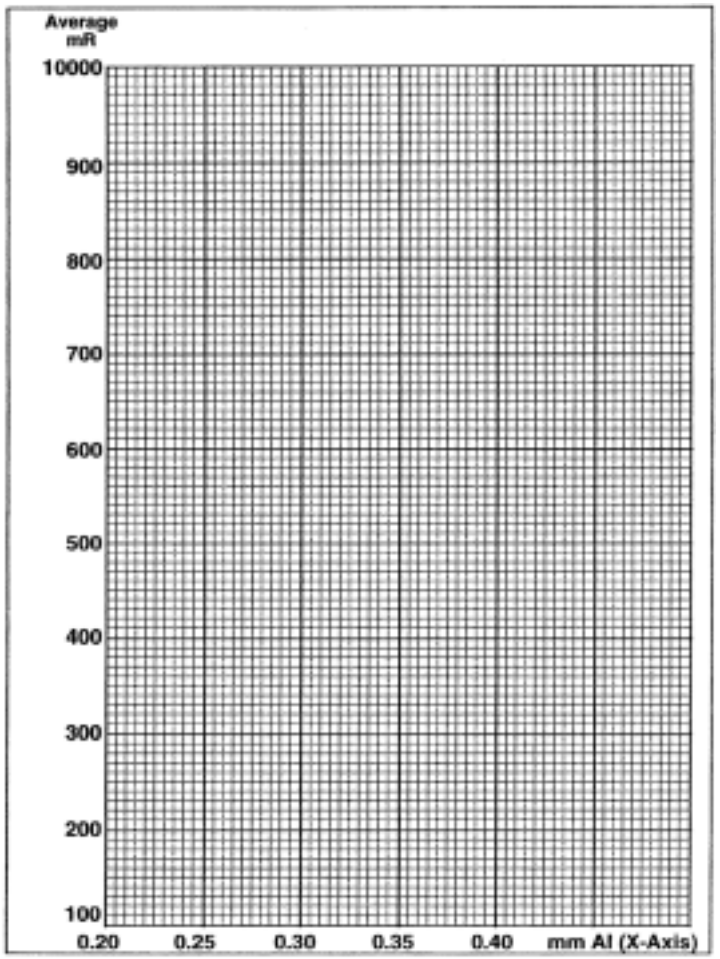
Specification: Manufacturing 0.315-0.400 315
Stated ≥0.300

*Points to be plotted (graph on next page)

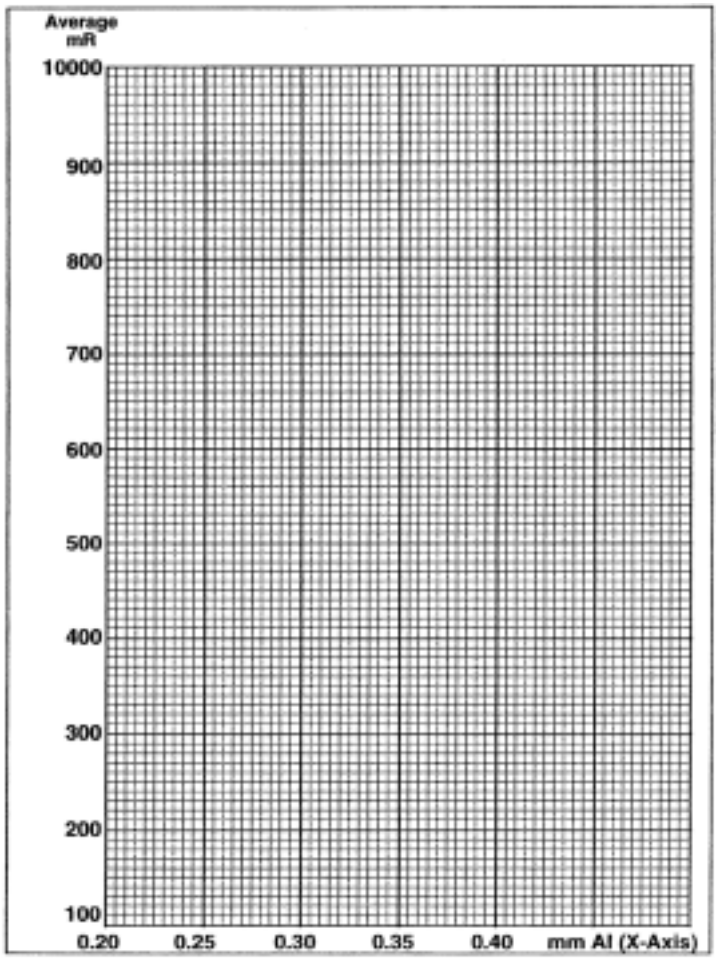
**Points to be plotted with an "X"

Beam Quality Half Value Layer Data, *continued*

Beam Quality Half Value Layer (30kV) - Part 2



Beam Quality Half Value Layer (30kV) - Part 3



Transmission Limit Data Sheet

Position	1	2	3
mR Reading			
Specification:	Manufacturing		≤0.0925
	Field		≤0.0950
	Stated		≤0.0975

Light-defined X-Ray Field Contrast Data

Illumination toward the center (I_{TC})		
Illumination from the center (I_{FC})		
$\text{Ratio} = \frac{I_{TC}}{I_{FC}} : \frac{I_{FC}}{I_{FC}}$		:
Specification:	Manufacturing	minimum of 4.6 : 1 ratio
	Field	minimum of 4.4 : 1 ratio
	Stated	minimum of 4.2 : 1 ratio

Example:

I_{TC} = 5.4

I_{FC} = 1.2

Ratio = 5.4/1.2 : 1.2/1.2

Ratio = 4.5 : 1

Illumination of Light Localization Data

Position Number	Total Illumination (with collimator lamp ON)	Ambient Room Light (with collimator lamp OFF)	Light Difference (D)
1			(D1)
2			(D2)
3			(D3)
4			(D4)
		D1 + D2 + D3 + D4 = Total Light	
		Total Light / 4 = Average Light	

Specification:	Manufacturing	minimum 187 LUX (17.4 footcandle)
	Field	minimum 177 LUX (16.4 footcandle)
	Stated	minimum 167 LUX (15.5 footcandle)

Leakage Radiation from Diagnostic Source Data

Position	mR Reading	Position	mR Reading
Set A-1		Set B-1	
Set A-2		Set B-2	
Set A-3		Set B-3	
Set A-4		Set B-4	
Set A-1		Set B-1	
Specification:	Manufacturing	must be less than 93 mR	
	Field	must be less than 95 mR	
	Stated	must be less than 97 mR	

Gain Adjustment and Reproducibility Data for the CompuTracII

mAs value after R9 adjustment				
Measured optical density at reference technique				
Exposure #	1	2	3	4
Actual mR				
Coefficient of variation				
Average mR				
Standard Deviation				
Specification:	Manufacturing		≤0.0325	
	Field		≤0.0350	

Density Compensation Verification Data

Last Digit of Serial Number	Set 1	Set 2	Set 3	Set 4
Plexiglas (cm)				
mA				
kV				
Optical Density				
mAs (actual)				
Specification:	1.25 ±0.3			

Density Control Verification

Density Selection	Target mAs	Actual mAs	Limits
+5	92		82.8 - 101.2
+4	84		75.6 - 92.4
+3	76		68.4 - 83.6
+2	68		61.2 - 74.8
+1	60		54.0 - 66.0
0	53		47.7 - 58.3
-1	45		40.5 - 49.5
-2	38		34.2 - 41.8
-3	31		27.9 - 34.1
-4	24		21.6 - 26.4
-5	19		17.1 - 20.9

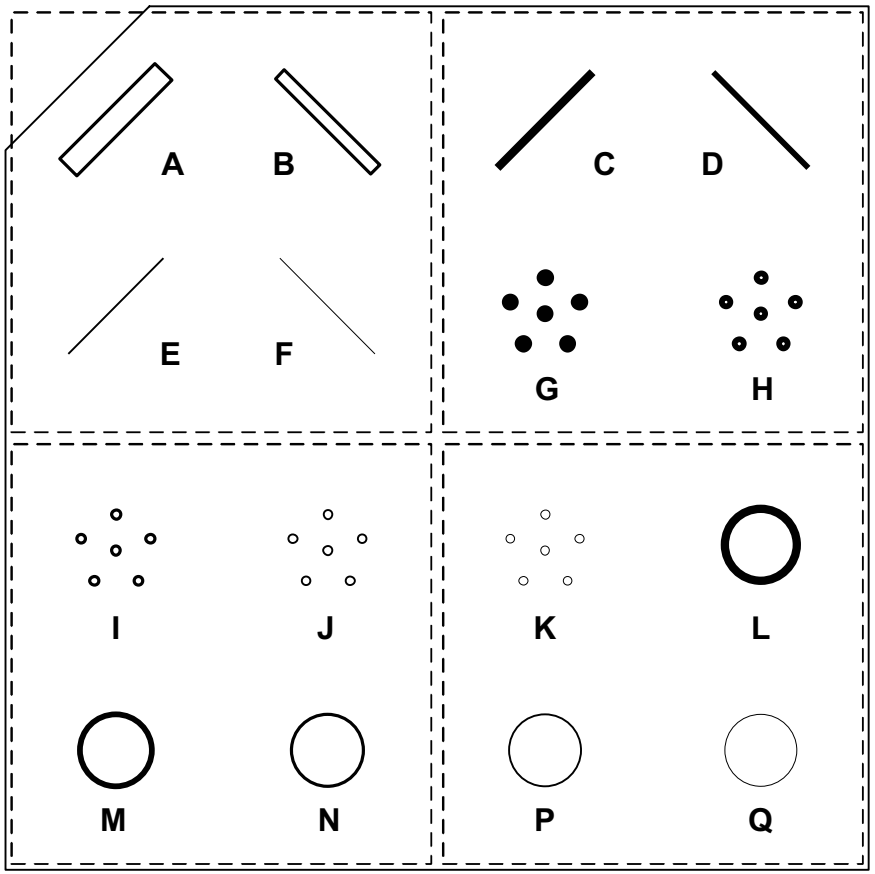
Back-Up Termination Verification Data

	Yes	No
Alarm at Termination		
Reset Lamp Blinking		
All Buttons Locked Out		
Reset Clears Fault		

Auto kV Step Verification Data

mA	Plexiglas	Final kV	mAs	Optical Density
100	6 cm			
100	7 cm			
25	6 cm			
25	7 cm			

RMI Model 156 Mammographic Accreditation Phantom Data for Film 1 (24 kV)



Determine:	Data
Optical Density	
Film 1 Score	

Fiber Scoring

+1 pt. for each full length fiber
+0.5 pt. for each fiber more than half visible
-1 pt. for each full length fiber artifact
-0.5 pt. for each half or more length fiber artifact

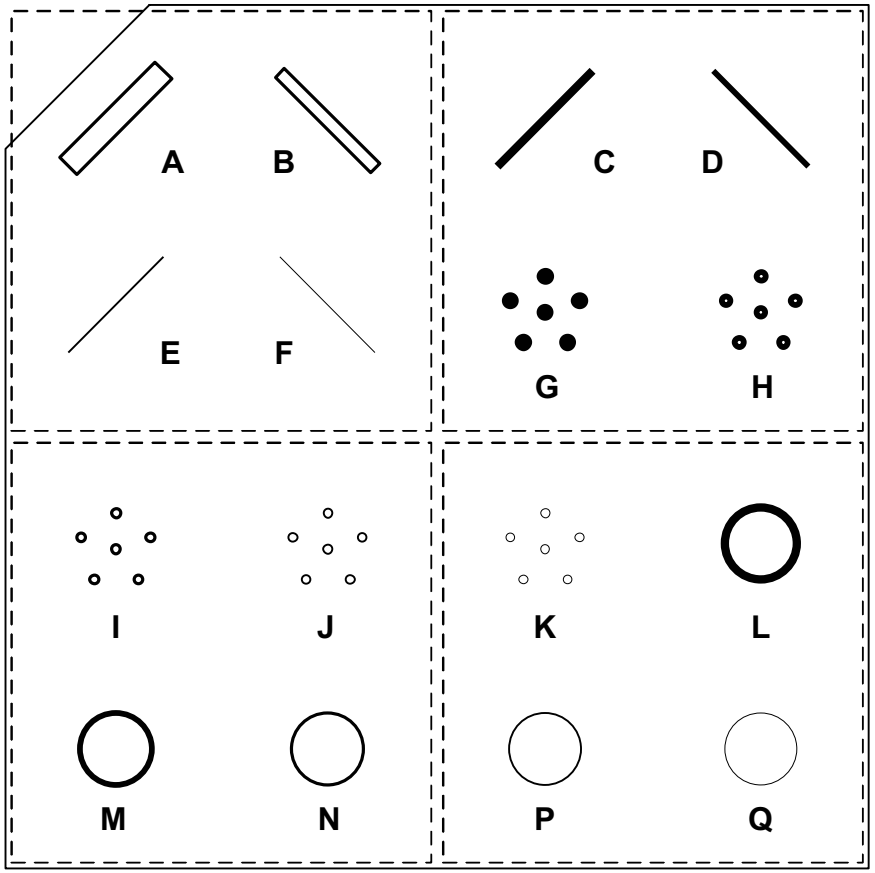
Speck Group Scoring

+1 pt. for a speck group with 4 or more specks
+0.5 pt. for a speck group with 2 or 3 specks
-1 pt. for a speck group artifact with 4 or more specks
-0.5 pt. for a speck group artifact with 2 or 3 specks

Mass Scoring

+1 pt. for each mass with a full circular edge
+0.5 pt. for each mass with a partial circular edge
-1 pt. for each mass artifact with a full circular edge
-0.5 pt. for each mass artifact with a partial circular edge

RMI Model 156 Mammographic Accreditation Phantom for Film 2 (25 kV)



Determine:	Data
Optical Density	
Film 2 Score	

Fiber Scoring

+1 pt. for each full length fiber
+0.5 pt. for each fiber more than half visible
-1 pt. for each full length fiber artifact
-0.5 pt. for each half or more length fiber artifact

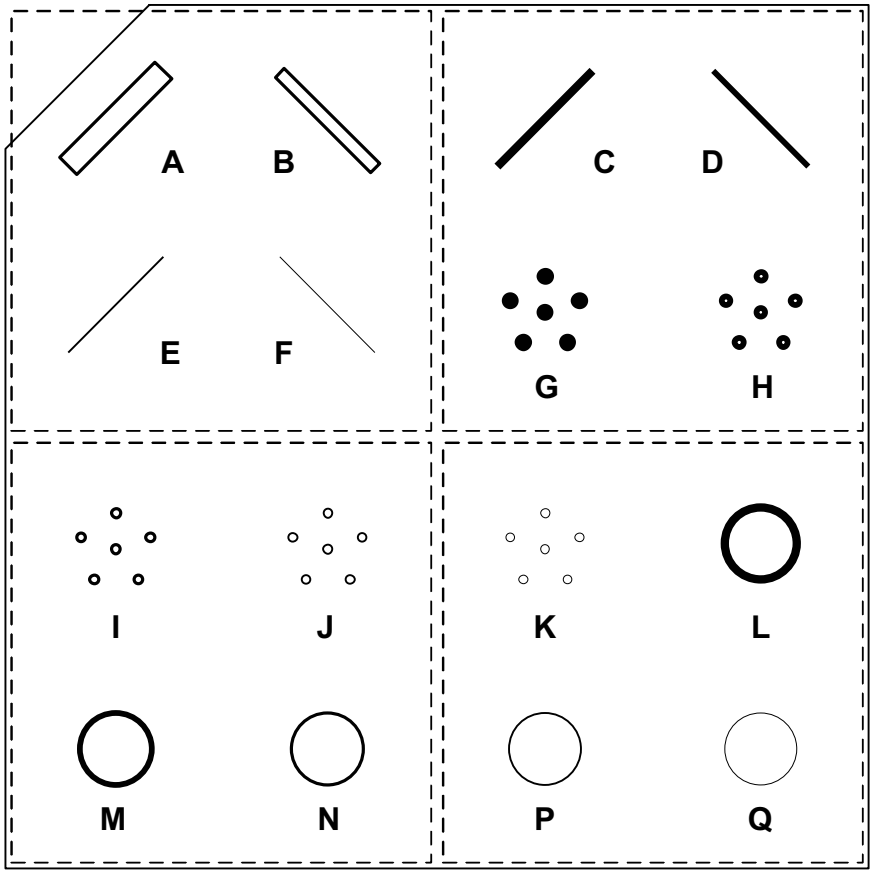
Speck Group Scoring

+1 pt. for a speck group with 4 or more specks
+0.5 pt. for a speck group with 2 or 3 specks
-1 pt. for a speck group artifact with 4 or more specks
-0.5 pt. for a speck group artifact with 2 or 3 specks

Mass Scoring

+1 pt. for each mass with a full circular edge
+0.5 pt. for each mass with a partial circular edge
-1 pt. for each mass artifact with a full circular edge
-0.5 pt. for each mass artifact with a partial circular edge

RMI Model 156 Mammographic Accreditation Phantom for Film 3 (26 kV)



Determine:	Data
Optical Density	
Film 3 Score	

Fiber Scoring

+1 pt. for each full length fiber
+0.5 pt. for each fiber more than half visible
-1 pt. for each full length fiber artifact
-0.5 pt. for each half or more length fiber artifact

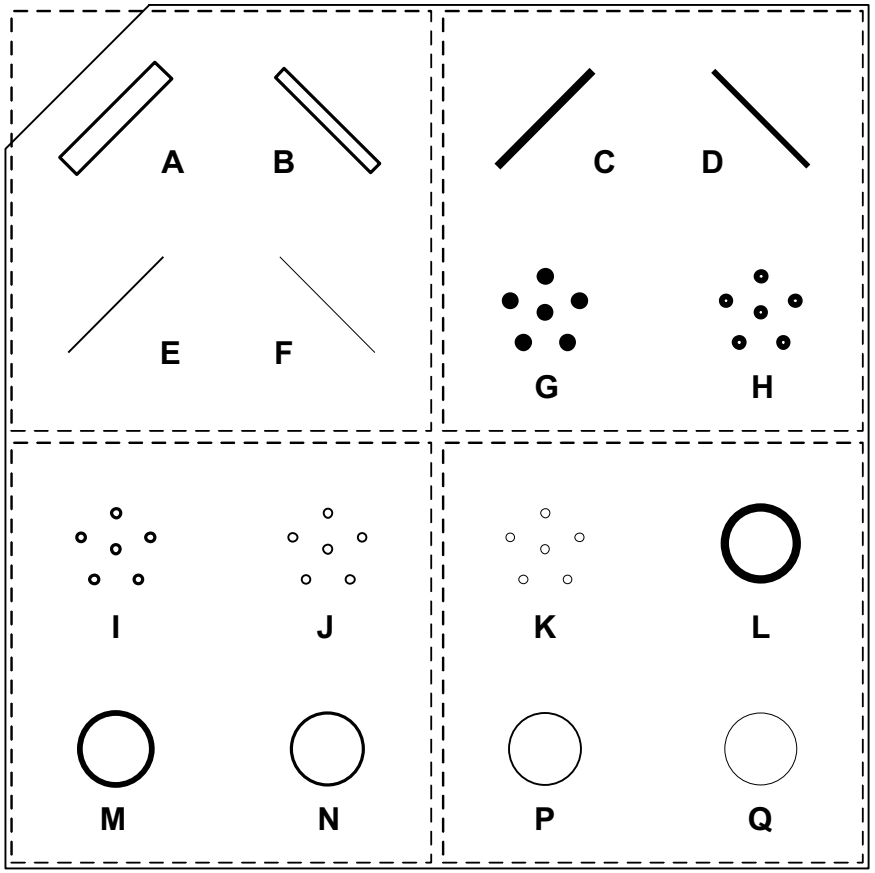
Speck Group Scoring

+1 pt. for a speck group with 4 or more specks
+0.5 pt. for a speck group with 2 or 3 specks
-1 pt. for a speck group artifact with 4 or more specks
-0.5 pt. for a speck group artifact with 2 or 3 specks

Mass Scoring

+1 pt. for each mass with a full circular edge
+0.5 pt. for each mass with a partial circular edge
-1 pt. for each mass artifact with a full circular edge
-0.5 pt. for each mass artifact with a partial circular edge

RMI Model 156 Mammographic Accreditation Phantom for Film 4 (23 kV)



Determine:	Data
Optical Density	
Film 4 Score	

Fiber Scoring

+1 pt. for each full length fiber
+0.5 pt. for each fiber more than half visible
-1 pt. for each full length fiber artifact
-0.5 pt. for each half or more length fiber artifact

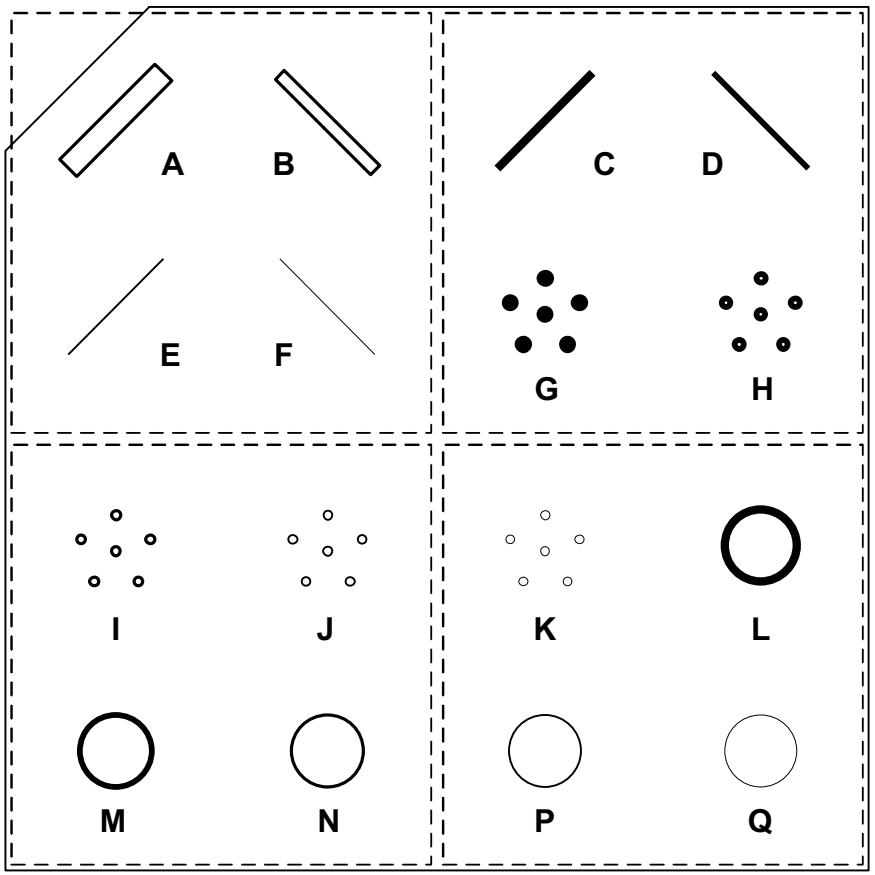
Speck Group Scoring

+1 pt. for a speck group with 4 or more specks
+0.5 pt. for a speck group with 2 or 3 specks
-1 pt. for a speck group artifact with 4 or more specks
-0.5 pt. for a speck group artifact with 2 or 3 specks

Mass Scoring

+1 pt. for each mass with a full circular edge
+0.5 pt. for each mass with a partial circular edge
-1 pt. for each mass artifact with a full circular edge
-0.5 pt. for each mass artifact with a partial circular edge

RMI Model 156 Mammographic Accreditation Phantom for Film 5 (24 kV)



Determine:	Data
Optical Density	
Film 5 Score	

Fiber Scoring

+1 pt. for each full length fiber
+0.5 pt. for each fiber more than half visible
-1 pt. for each full length fiber artifact
-0.5 pt. for each half or more length fiber artifact

Speck Group Scoring

+1 pt. for a speck group with 4 or more specks
+0.5 pt. for a speck group with 2 or 3 specks
-1 pt. for a speck group artifact with 4 or more specks
-0.5 pt. for a speck group artifact with 2 or 3 specks

Mass Scoring

+1 pt. for each mass with a full circular edge
+0.5 pt. for each mass with a partial circular edge
-1 pt. for each mass artifact with a full circular edge
-0.5 pt. for each mass artifact with a partial circular edge

RMI Model 156 Mammographic Accreditation Phantom Scoring

Fiber			Specks			Masses		
Letter	Size	Points	Letter	Size	Points	Letter	Size	Points
A	1.56 mm	1	G	0.54 mm	1	L	2 mm	1
B	1.12 mm	1	H	0.40 mm	1	M	1 mm	1
C	0.89 mm	3	I	0.32 mm	6	N	0.75 mm	1
D	0.75 mm	5	J	0.24 mm	7	P	0.5 mm	7
E	0.54 mm	9	K	0.16 mm	10	Q	0.25 mm	10
F	0.40 mm	10						

*Score 1 point if at least three of the six specs are visible.

Scores (with Bucky)

Film 1 (24kV) _____

Film 2 (25kV) _____

Film 3 (26kV) _____

Total Score _____

Scores (without Bucky)

Film 1 (23kV) _____

Film 2 (24kV) _____

Total Score _____

Criteria

- Each individual film should have a score of 21 or greater.
- The total score for films 1 to 3 (with Bucky) must be 84 or greater.
- The total score for films 4 to 5 (without Bucky) must be 49 or greater.

Mammovision System Configuration Information

Tested by: _____

Date: _____

Hospital: _____

Job Number: _____

Dealer/Branch: _____

	Part Number	Serial Number
System		
X-Ray Control		
Mammotest Table		
Mammovision		
AutoGuide		
Lateral Arm		
Digitizer Console Option		

Mammovision Test Equipment Information

Equipment	Serial Number
Mammographic Accreditation Phantom	
Radcal X-Ray Monitor (or equivalent dosimeter)	
DVM Meter	

Mammotest Table Test Data

Test	Yes	No
1. Vertical motion of the table verified		
2. Vertical motion of the arm verified		
3. Longitudinal movement of the table verified		
4. Panning motion of the table verified		
5. "Enable" ON - Table moves and AutoGuide movement is disabled		
6. "Enable" OFF - Table movement is disabled and AutoGuide movement is enabled		
Comments:		

Automatic Exposure Control Data

Raw Sum 1: _____

Raw Sum 2: _____

Raw Sum Average: _____

Dark Sum 1: _____

Dark Sum 2: _____

Dark Sum Average: _____

Raw Sum Avg. - Dark Sum Avg. = _____

Standard Value = _____

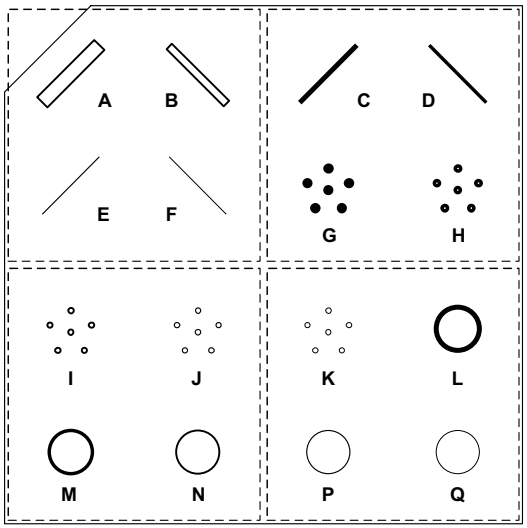
Standard Value x 2% = _____

Verify that the total is within ±2%

Initials: _____

RMI Model 156 Mammographic Accredation Phantom (1-25 kV) Data

Store A



Store B

Store C

Store D

Image	Fibers	Specks	Masses	Total
Image A Score				
Image B Score				
Image C Score				
Image D Score				

Criteria:

	Minimum Scores	
	RMI Phantom	DME Phantom
Fibers	5	3
Speck Sets	4	3
Masses	3.5	2.5
Total	112.5	8.5

Phantom Used: _____

mAs: _____

Average Background Value: _____

AEC Reproducibility Data

Test Settings:
X-Ray Tube Potential: 26kV
X-Ray Tube Current: 100mA
AEC Sensitivity: _____
Low Dose: _____
Standard: _____
High Resolution: _____

Exposure	mR
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Calculate the coefficient of variation for the 10 dose readings using the formula below.

$$\text{Coeffiicient of Variation} = \frac{s}{\bar{x}} = \frac{1}{\bar{x}}\left[\sum_{i=1}^{n}\frac{(x_i-\bar{x})^2}{n-1}\right]^{\frac{1}{2}}$$

where:

$\underline{s}$ = estimated standard deviation of the population
$\bar{x}$ = mean value of observation in sample
x_i = ith observation sampled
n = number of observations sampled (10)

Coefficient of Variation: _____

Acceptable Levels:
Coefficient of Variation Limit: ≤ 0.035

Positioner Motion Test Data

System Checked	Yes	No
Enable Switch Operation		
Positioner Drives to Origin		
Plus vertical motion (up) of positioner to +15° with surgical and +12° with non-surgical AutoGuide		
Minus vertical motion (down) of positioner to -5° with surgical and -4° with non-surgical AutoGuide		
Minus horizontal motion (left) of positioner to +12° with surgical and +10° with non-surgical AutoGuide		
Plus horizontal motion (right) of positioner to +12° with surgical and +10° with non-surgical AutoGuide		
Comments:		

Frontal Approach Position and Depth Accuracy Data

Test	Depth Reading	Yes	No
Target 1 position and depth in tolerance (±1 mm)?			
Target 2 position and depth in tolerance (±1 mm)?			
Target 3 position and depth in tolerance (±1 mm)?			
Comments:			

Patient Left Position and Depth Accuracy Data

Test	Depth Reading	Yes	No
Target 1 position and depth in tolerance (±1 mm)?			
Target 2 position and depth in tolerance (±1 mm)?			
Target 3 position and depth in tolerance (±1 mm)?			
Comments:			

Patient Right Position and Depth Accuracy Data

Test	Depth Reading	Yes	No
Target 1 position and depth in tolerance (±1 mm)?			
Target 2 position and depth in tolerance (±1 mm)?			
Target 3 position and depth in tolerance (±1 mm)?			
Comments:			

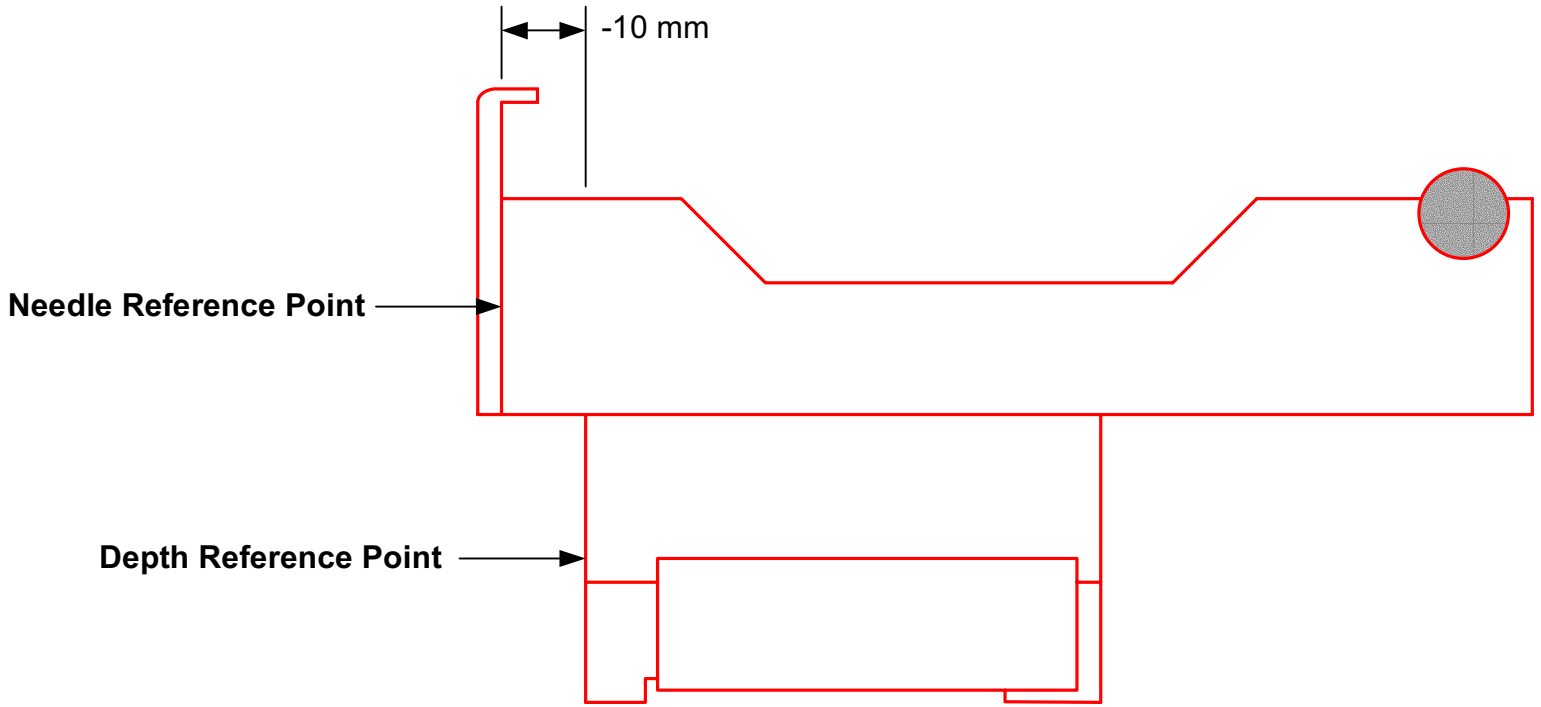
Software Data Values

Focal Spot		mA Boost Values			
	mA Station	20 kV	28 kV	36 kV	44 kV
Small	15				
	25				
	30				
Large	100				
	125				

Needle and Needle Holder Data

Holder Name	Holder Length	Needle Name	Needle Gauge	Needle Length	Gun Stroke	Backup

Sample Needle Holder Reference Points



Bard® Biopty® Gun

P/N 71995G
Length: -10 mm

Figure 7: Bard® Biopty® Gun

Sample Needle Holder Reference Points, *continued*

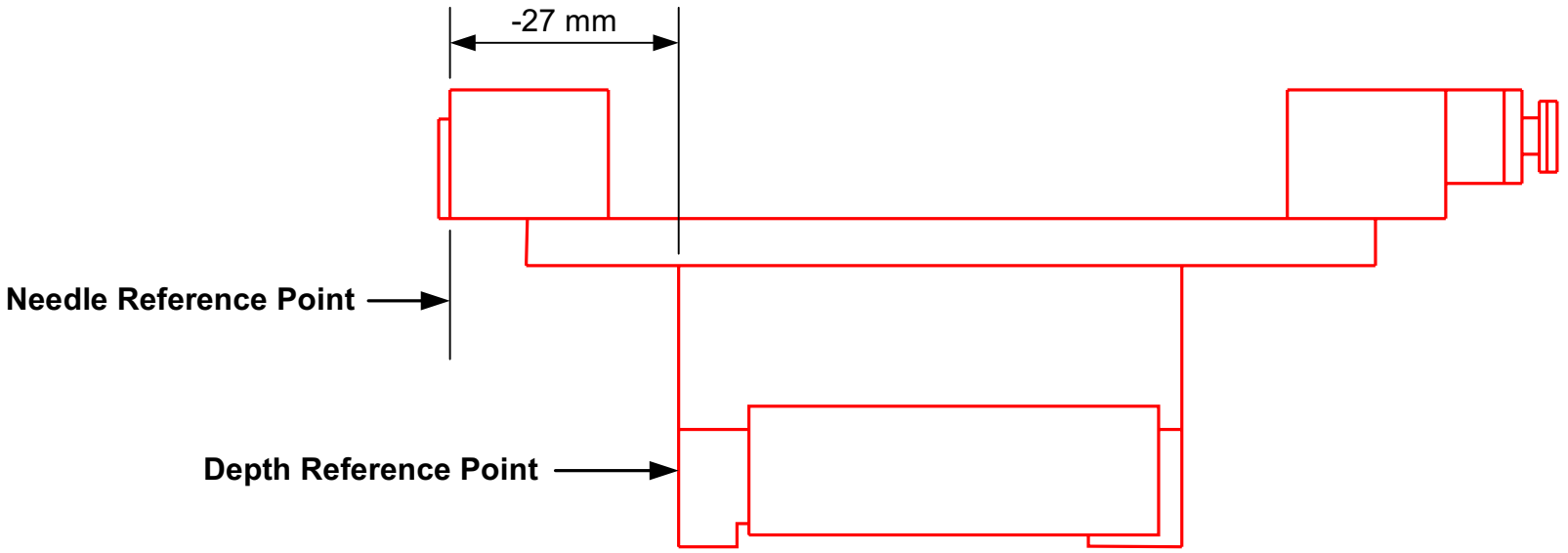
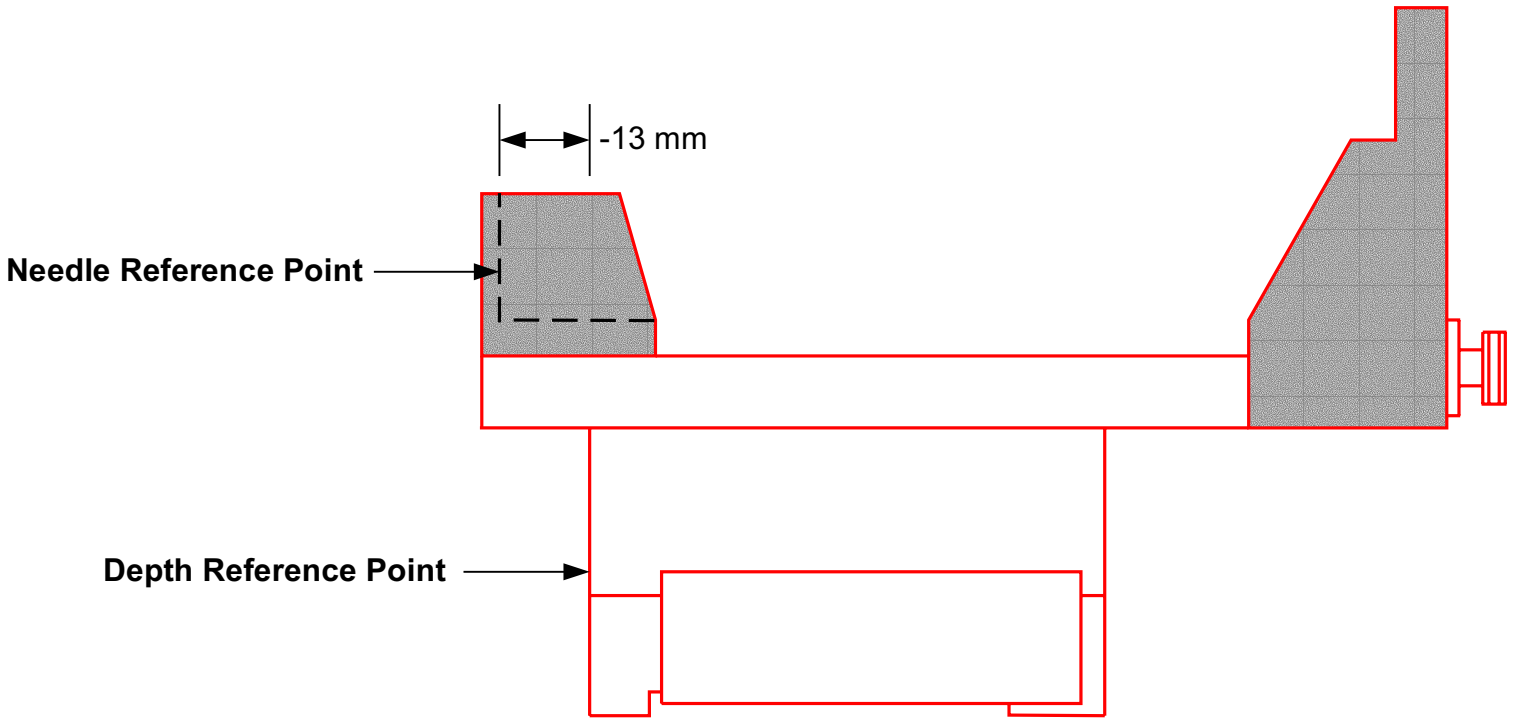


Figure 8: Microvasive ASAP™ Gun

Sample Needle Holder Reference Points, *continued*



Bard® Monopty® Gun

P/N 71995G-2
Length: -13 mm

Figure 9: Bard® Monopty® Gun

Sample Needle Holder Reference Points, *continued*

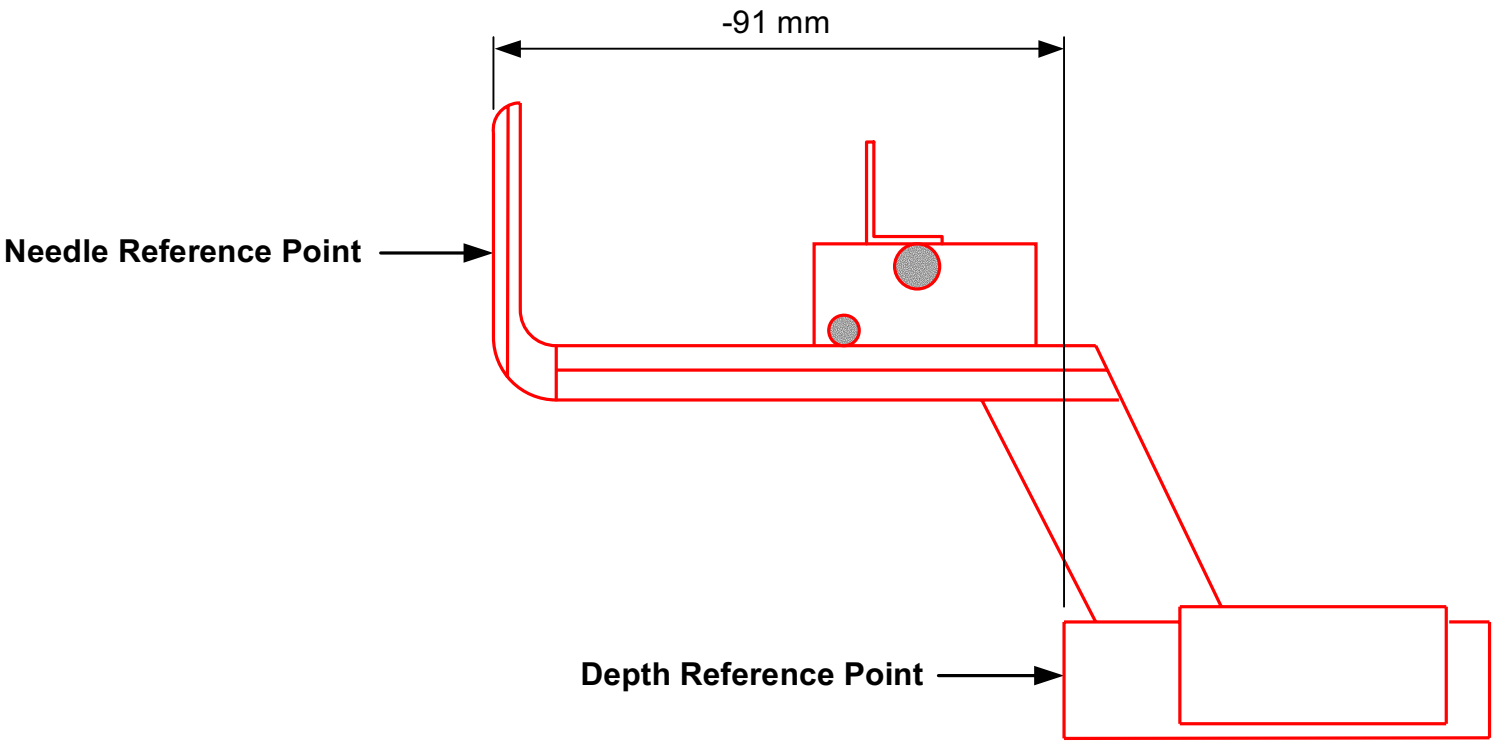
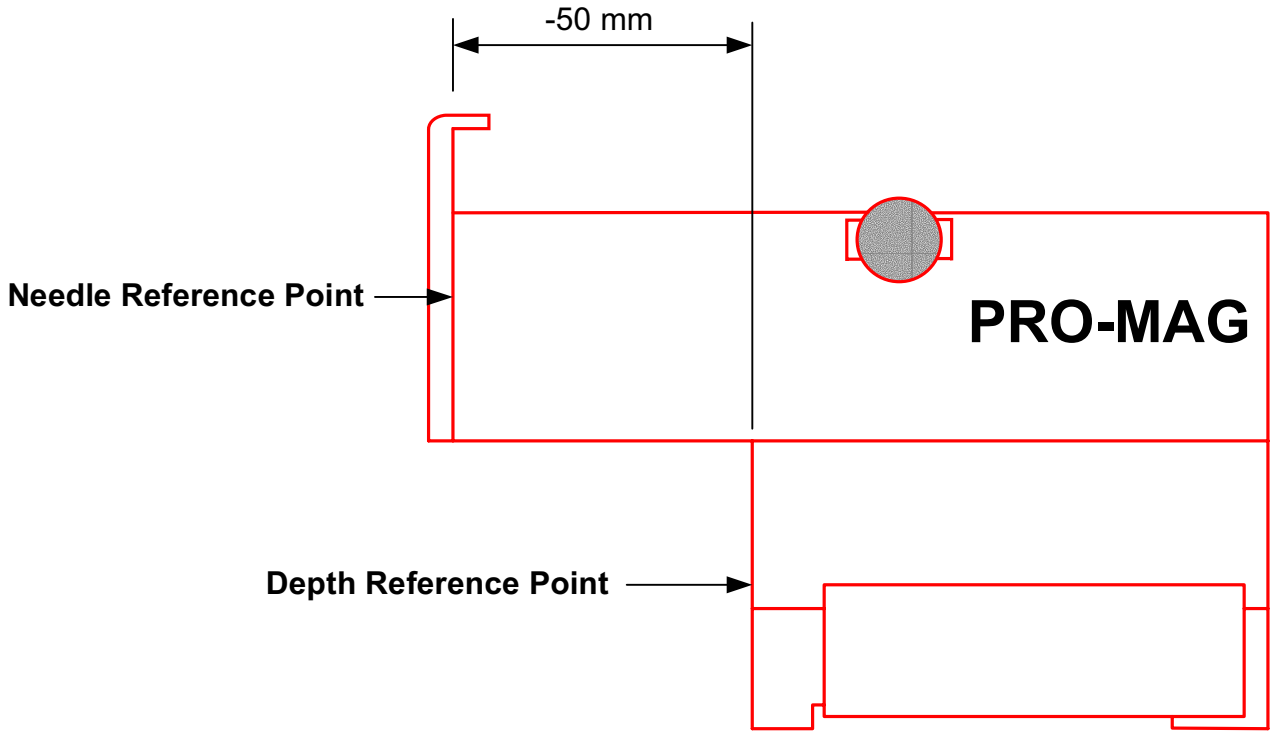


Figure 10: Universal 2™ Needle Holder

Sample Needle Holder Reference Points, *continued*

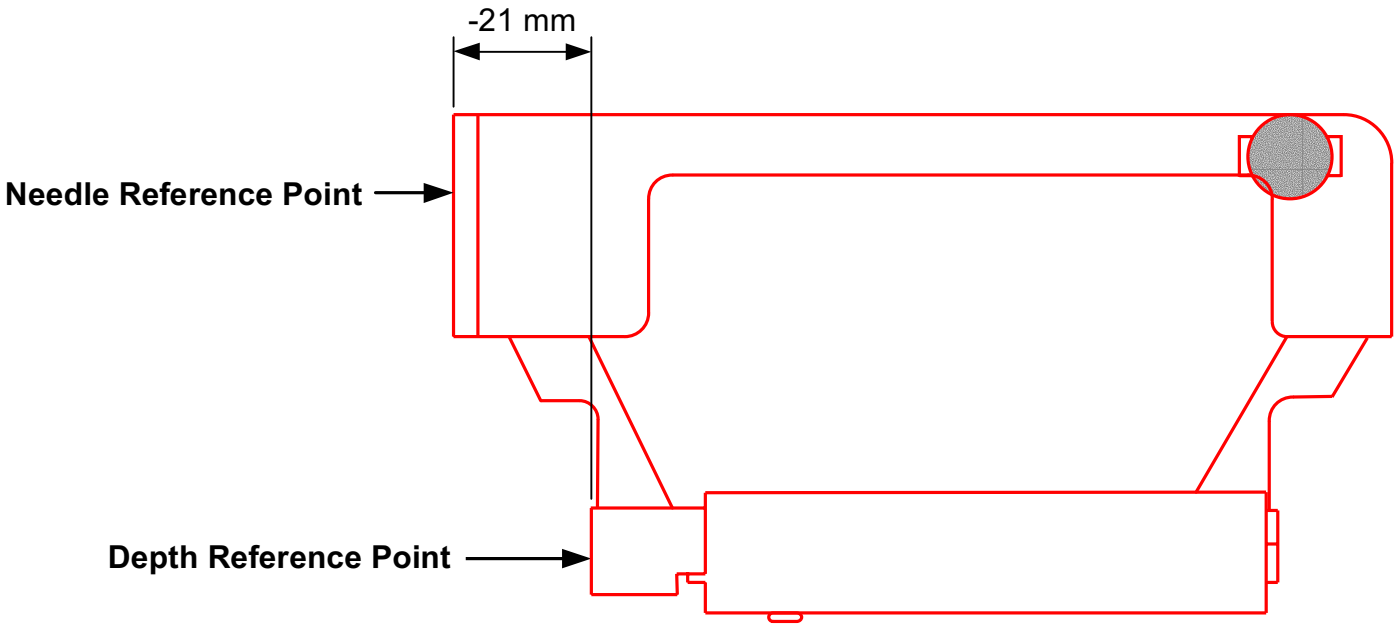


PRO-MAG 2.2

P/N 72130G
Length: -50 mm

Figure 11: Pro-Mag 2.2

Sample Needle Holder Reference Points, *continued*

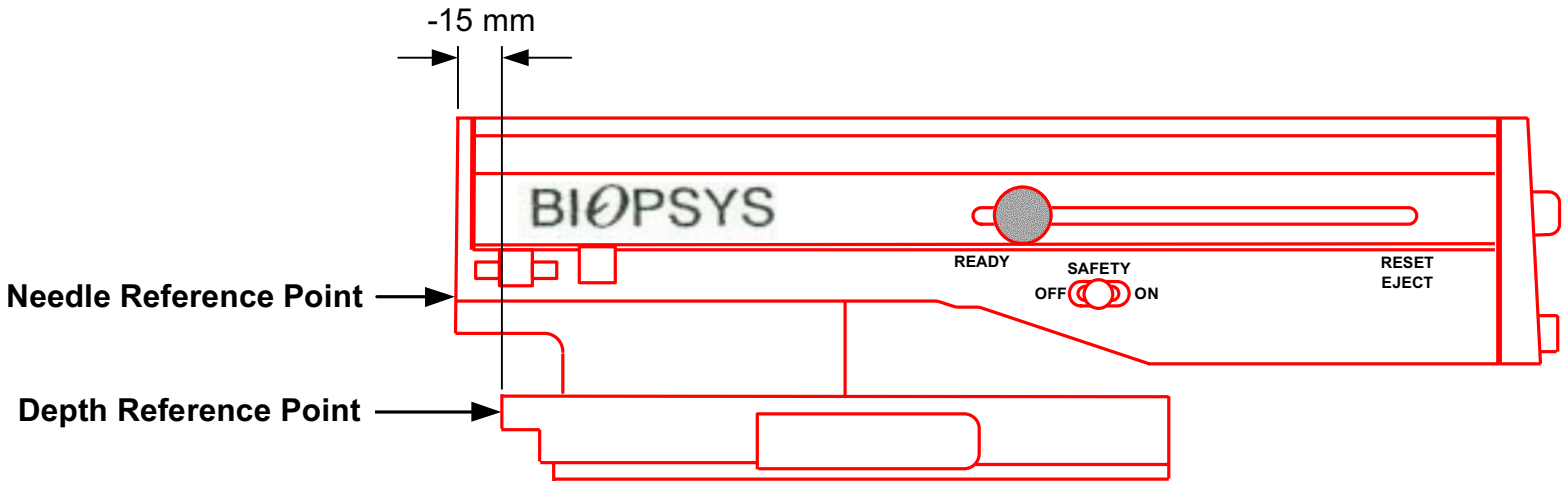


Bard Magnum Gun (former BIP Multi Gun)

P/N 72450G
Length: -21 mm

Figure 12: Bard® Magnum (formerly BIP Multi) Gun

Sample Needle Holder Reference Points, *continued*

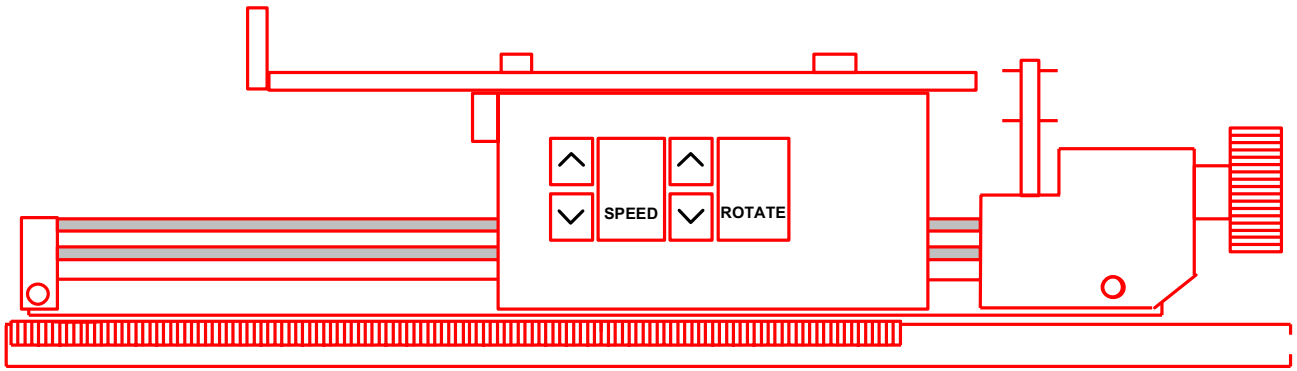


Mammotome M otorized Driver

P/N 71570-1
Length: -15 mm

Figure 13: Mammotome™ Motorized Driver

Sample Needle Holder Reference Points, *continued*



Adapter Driver

P/N 85690G-1
Length:

Figure 14: Adapter Driver

FEEDBACK TO AUTHOR

If you have comments or suggestions, please email them to:

EPST.feedback@med.ge.com